Biological Elements

OLD-GROWTH

Affected Environment

The Forest Service, Southern Region, recognizes old-growth forests as a valuable natural resource worthy of protection, restoration, and management. In 1989, then-Forest Service Chief Dale Robertson issued a national position statement on old-growth forests (USDA Forest Service 1989a, 1997b). He provided this definition:

> Old-growth forests are ecosystems distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulation of large wood material, number of canopy layers, species composition, and ecosystem function.
>
> The age at which old-growth develops and the specific structural attributes that characterize old-growth will vary widely according to forest type, climate, site conditions, and disturbance regime. Old-growth in fire-dependent forest types may not differ from younger forests in the number of canopy layers or accumulation of down woody material. However, old-growth is typically distinguished from younger growth by several of the following attributes:
>
> 1) Large trees for the species and site
> 2) Wide variation in tree sizes and spacing
> 3) Accumulations of large-sized dead standing and fallen trees that are high relative to earlier stages
> 4) Decadence in the form of broken or deformed tops or boles and root decay
> 5) Multiple canopy layers
> 6) Canopy gaps and understory patchiness.

Old-growth forests provide a variety of values, such as: biological diversity, wildlife habitat, recreation, aesthetics, soil productivity, water quality, aquatic habitat, and cultural values as well as high-value timber products on a small scale. According to Hunter (1989), it is probably neither possible nor desirable to craft a universal definition of old-growth.

Old-growth communities are rare or largely absent in the southeastern forests of the United States. Only about 0.5 percent of the total forest acreage in the southeast (approximately 108.4 million acres) is currently old-growth (Davis 1996 in USDA Forest Service 1997b). Within its nearly 700,000-acre land base, the DBNF has about 2,000 acres of trees older than 150 years, but less than 1,000 acres of trees older than 200 years, according to the Continuous Inventory of Stand Condition (CISC). Currently, none is managed for old-growth attributes. For these reasons, the DBNF is addressing the restoration of this portion of the southern forest ecosystem. Decisions made regarding old-growth during Plan revision are based on ecological principles, social values, and legal requirements.

Current federal laws and regulations governing National Forests do not specifically mandate management for old-growth conditions. However, various laws do provide direction to the Forest Service for:

- Management of multiple natural resources and values
- Protection and recovery of PETS species
- Provision of habitats to sustain viable populations of native plants and animals
- Maintaining and enhancing the diversity of plant and animal communities.

These concerns can be addressed in part by establishing and maintaining a network of old-growth across National Forest System lands.

As opposed to merely an area of "old trees," an area of functional old-growth is generally understood to be an area of ecological integrity. Old trees are only one biotic component of the old-growth condition, and functionality is scale-dependent. The larger the area, the more likely that species requiring interior habitat rather than edge habitat will be present. Additionally, an area must be of a minimal size, with some minimum width to minimize edge effect and maximize substantial interior that will buffer outside influences. (A circle or octagon is better than a long, narrow strip.) As a result, the area may be more resilient to environmental events such as windstorms, insect and disease outbreaks, and fire. The larger the area, the more likely old-growth conditions will persist after disturbance with most of its distinguishing characteristics and vegetative layers intact. However, for even moderate resiliency to insect and disease infestation, an area may need to be tens of thousands of acres in size. The DBNF suggests that an area must be no smaller than 300 acres in size to be considered as functional old-growth (Martin 1992).

Some species require older, large, live trees for part of their life cycle. One species on the DBNF, the sixbanded longhorn beetle, appears to be old-growth-dependent. This insect requires large decadent beech and sugar maples for its larval stage. Whether this species requires functional old-growth or just patches of old trees is unclear, however. Old-growth may provide habitat for species that remain unidentified. Additionally, species not now appearing in this area could colonize this habitat, or begin to express them in a visible manner, once old-growth is established.

Thus, the concept of old-growth encompasses more than the presence of "old" trees. Different forest communities reach old-growth conditions at different ages, under different disturbance regimes, and via different management strategies. The DBNF has identified eight major old-growth communities based on the report, Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region (USDA Forest Service 1997b). To be identified as old-growth, a stand must meet the following four criteria. Three are detailed in Table 3 - 25.

- Minimum age of the oldest existing age class
- Minimum basal area
- Minimum diameter at breast height (DBH) of the largest trees in the stand
- Disturbance history.

To address social concerns brought out by the public, areas to be considered should have minimal evidence of past human disturbance. However, recent management activities that are not inconsistent with old-growth, including prescribed burning, some silvicultural practices, and trail maintenance might not disqualify a stand from management as old-growth.

Table 3 - 25. Three of the four qualifying criteria for old-growth on the DBNF.[1]

Community	Minimum age of the oldest existing age class (years)	Minimum basal area (sq. ft/acre)	DBH of largest trees (inches)
Conifer-northern hardwood forest	140	40	≥20
Mixed mesophytic forest	140[2]	40	≥30
River floodplain hardwood forest	100	40	≥16
Dry-mesic oak forest and woodland	130[2]	40	≥20
Dry and xeric oak forest, woodland, wooded grassland/shrubland	110[2]	10	≥16
Xeric yellow pine and yellow pine-oak forest woodland and wooded grassland/shrubland	100	20	≥10
Dry and dry-mesic oak-yellow pine forest and woodland	120[2]	40	≥19
Eastern riverfront forest	100[2]	40	≥25

[1] Criterian 4 is disturbance history. Criteria adapted from USDA Forest Service 1997b.

The existence on the DBNF of old-growth, based on the sum of criteria in Table 3 - 25, has not been confirmed through field inventories, although some stands meet the age criterion. The DBNF did not manage any areas specifically for old-growth conditions under the 1985 Plan. However, *future* old-growth and/or *possible* old-growth stands were identified.

Future old-growth (FOG) consists of any Prescription Area managed in such a way that old-growth characteristics will tend to prevail in the future and across a large spatial scale. These areas may include: Research Natural Areas, Wilderness areas, Wild & Scenic River corridors, Red River Gorge, Natural Arch Scenic Area, Cliffline corridor, Significant bat cave areas, Riparian corridor, and Source water protection areas (300 ft. zone). In these locations, few improvements exist or are planned, and vegetation management is limited primarily to benefit habitat or to improve the condition for which the area was established. Manipulation in these areas is limited. Stands of trees will likely not be harvested, a wide range of tree sizes may exist, snags and logs often remain, soil compaction is minimized, interior-dependent species may use the area, and other characteristics of old-growth will be evident. However, the identification of an area as FOG does not imply that management will always promote old-growth characteristics in general or any community type in particular. FOG has no minimum stand age requirement because the area is moving toward old-growth on a long temporal scale.

Possible old-growth (POG) are stands likely to qualify as old-growth based on old-growth community type and stand age (Table 3 - 25). Through an examination of stand age (CISC database adjusted for year 2003, USDA Forest Service 1997a) all stands meeting old-growth age criteria were identified as possible old growth and documented in the Preliminary Inventory of Possible Old Growth, as described in Forest Report R8-FR-62. These POG stands are embedded in, and a part of, the various prescription areas across the forest. About 12,000 acres of POG have been identified and mapped (Table 3 - 27).

Table 3 - 26. Possible Old Growth on the DBNF.

Community	Pre-SPB (acres)	Post-SPB (acres)
Conifer-northern hardwood forest	1,400	1,400
Mixed mesophytic forest	728	728
River floodplain hardwood forest	61	61
Dry-mesic oak forest	532	532
Dry and xeric oak forest	1,483	1,483
Xeric yellow pine and yellow pine-oak forest	11,017	7,065
Dry and dry-mesic oak-yellow pine forest	912	912
TOTAL Acres	16,133	12,181

Change detection in Landsat Imagery was utilized to estimate the decrease in the dry-xeric pine and pine oak type resulting from the Southern Pine Beetle infestation.

The identification of a stand as *possible* old-growth does not imply any management decision regarding its status as old-growth. Management that could alter the stand's potential old-growth condition will be deferred until it has been inventoried and conditions determined. If the stand is identified as *existing* old-growth, that analysis will be followed by a project-level decision as to whether it will be managed as such. These decisions will be disclosed to the public. Stands managed as old-growth will be included in the 1.I. Designated Old-Growth Prescription Area. These stands will be addressed site-specifically during Forest Plan implementation, regardless of the alternative chosen. Over the life of the Plan, additional POG areas will be identified during project planning. These additional stands will be treated like the POG stands of the preliminary survey, with inventory of old-growth features taken and a determination of old-growth made and disclosed to the public prior to any management within the stand.

The area for this analysis includes all lands within the DBNF proclamation boundary.

Direct and Indirect Effects

COMMON TO ALL ALTERNATIVES

As the Forest ages, species that are found in old-age mesic stands in general, or old-growth mixed mesophytic forest in particular, will increasingly benefit as shade-tolerant species become more prevalent across the landscape. However, other species may decline since upland site species composition will change, tending to support less yellow pine, oak, and associated species. Exceptions will include areas where management emphasizes the thinning and burning required to maintain these communities described in USDA Forest Service (1997b), or edaphic conditions are such that xeric species dominate even without manipulation.

Across all alternatives, several Prescription Areas are regarded as *future* old-growth (FOG) because they may move toward old-growth conditions as a result of minimal treatment (Table 3 - 27). These areas include: Research Natural Areas (existing and proposed), Beaver Creek Wilderness, Clifty Wilderness, Wild and Scenic Rivers, Red River Gorge, and Natural Arch Scenic Area. Other prescription areas regarded as FOG include the Cliffline Community and Significant Bat Caves protection areas. Approximately 155,400 acres in these eight Prescription Areas are moving toward old-growth conditions. Although roads, improvements, and other signs of human manipulation exist, old-growth characteristics could eventually dominate the landscape of these areas. Promotion of old-growth characteristics, however, will not supersede the primary management objectives for which a Prescription Area was established. Land in these Prescription Areas will not be managed as old-growth, even though the majority of each probably will exhibit at least some old-growth characteristics, if nothing more than the existence of old trees.

All eight old-growth communities are found within these Prescription Areas. These include fire – adapted communities of two types, fire-mediated communities in which fire contributes heavily to composition and structure, and fire-influence communities in which fire contributes little to composition and structure. Fire-mediated habitat types (dry-mesic oak; dry and xeric oak; xeric pine and pine-oak; and dry and dry-mesic oak-pine forests) make up about 62 percent of the FOG areas described above. The prescribed fire and thinning required for restoration and perpetuation of these communities might conflict with other management objectives. As a result, the species composition in these systems would most likely move towards that found in mixed mesophytic communities. Thus, over time, yellow pine and oak communities may no longer be well represented across these FOG areas.

About 1,300 acres within mixed mesophytic forest have been identified as beech or beech/sugar-maple of varying ages. These stands may be available for sixbanded longhorn beetle habitat. Additional potential habitat likely exists within the mixed mesophytic type because stands containing a beech or sugar maple component are not always identified within CISC.

Based on regional direction (USDA Forest Service 1997b), POG stands will be field-inventoried for old-growth criteria. Eligible areas will be identified and could be managed as old-growth regardless of the surrounding prescription area. POG stands managed for old-growth conditions would be incorporated into the 1.I. Designated Old Growth prescription. Forest Service regulations set no minimum acreage or distribution criteria for old-growth, but once a stand is classified as old-growth, the direction in the plan is that it will be managed as such for the life of the Plan. Small or isolated stands might not qualify as functional old-growth, but may serve well to meet social/visual interests.

Table 3 - 27. Acres of *future* old-growth (FOG) by community, in Prescription Areas common to all alternatives.

Prescription area	Alternative[1]	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic Oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland[2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Uninventoried acres	Beech (totals included in mixed mesophytic forest)	Total acreage
1.A. Research Natural Areas	A	211	252	0	168	0	0	427	0	0	0	658
	B-1, C, C-1, D, and E-1	73	60	0	74	0	0	0	0	0	0	207
2.A & 2.B. Clifty & Beaver Creek Wilderness	A	4,424	1,695	0	2,837	1,896	1,670	480	0	47	10	13,059
	B-1, C, C-1, D, and E-1	1,229	581	0	1,723	1,550	1,138	349	0	16	3	6,586
1.C. Cliffline community	A	8,519	25,370	214	36,199	5,841	20,685	10,934	17	1,694	1,008	109,473
	B-1, C, C-1, D, and E-1	5,562	22,103	180	32,366	5,485	18,203	9,688	13	1,394	903	94,994
1.J. Significant bat caves	A	167	1,577	145	1,664	162	511	411	0	141	91	4,778
	B-1, C, C-1, D, and E-1	66	886	53	1,303	125	364	312	0	68	44	3,177
3.C. Wild & Scenic rivers	A	1,475	4,169	234	5,628	299	1,691	1,050	34	736	222	15,316
	B-1, C, C-1, D, and E-1	520	2,035	33	3,600	235	953	640	0	87	118	8,103
3.E. Red River Gorge[3]	A	2,218	2,883	20	3,127	2,068	807	521	0	90	0	11,734
	B-1, C, C-1, D, and E-1	1,037	1,533	1	1,990	1,841	631	501	0	9	0	7,543
3.F. Natural Arch Scenic Area	A	84	45	0	130	0	262	188	0	0	0	709
	B-1, C, C-1, D, and E-1	20	29	0	105	0	212	141	0	0	0	507
Totals	A	16,983	35,927	613	49,708	10,266	25,626	13,588	51	2,708	1,331	155,480
	B-1, C, C-1, D, and E-1	8,490	27,236	267	41,155	9,236	21,501	11,631	13	1,574	1,068	121,103

[1]Prescription Areas overlap in Alternatives B-1, C, C-1, D, and E-1 but not in A. The totals in columns reflect acreages that remain after the overlap has been removed. Overlapping acres have been included in the most restrictive Prescription Area.

[2]These acres have not been re-evaluated following the southern pine beetle epidemic, and may now have a severely diminished yellow pine component.

[3]In Alternative B-1, the Wilderness Study Area would be carved from 3.E. Red River Gorge Prescription Area. There would be no change in total FOG acreage.

ALTERNATIVE A

Under Alternative A, no stands or areas would be reserved specifically to conduct old-growth management or promote functionality in a Prescription Area (compare to Alternatives C, C-1, D and E-1, which include the 1.I. Designated Old-Growth Prescription Area). No areas would be managed specifically to maintain the old trees required for sixbanded longhorn beetle habitat. However, FOG areas would provide at least 1,300 acres of beech and sugar maple stands within mixed mesophytic forest that will, As these stands age, however, they will providing old-growth habitat.

Alternative A would call for the planting and restoration of almost 21,000 acres of yellow pine on National Forest System land in the first 10 years of the 2004 Plan. Another 30,000 acres would be planted over the next 70 years. Although this alternative has no Designated Old-Growth Prescription Area, it would provide for the most yellow pine restoration. Many of these stands would be managed for the possible re-introduction of red-cockaded woodpeckers, a species that requires mature, open yellow-pine communities. Even though these acres would not be managed for, or protected as, old-growth, most stands could reach at least 100 years of age, the defined minimum age for old-growth xeric pine and pine-oak forest and woodland (USDA Forest Service 1997b). National Forest System land would then provide, by far, the largest patchwork of mature pine stands within the proclamation boundary.

ALTERNATIVE B-1

As in Alternative A, there would be no Designated Old-Growth Prescription Area reserved specifically to conduct old-growth management and promote functionality. However, because the Desired Future Condition in Alternative B-1 would result in a landscape across which timber harvests and other human manipulation is minimized, nearly all of DBNF would move toward old-age mixed mesophytic forests. Therefore, old-growth characteristics would tend to prevail, and most of DBNF's 700,000 acres would be moving toward *future* old-growth.

Along with Prescription Areas common to all alternatives that are FOG (Table 3 - 27), two other Prescription Areas, Riparian Corridor and Source Water Emphasis, would be found in this alternative as well as Alternatives C, C-1, D, and E-1 (Table 3 - 28). The Custodial Prescription Area, unique to this alternative, would increase FOG by approximately 395,000 acres. The Wilderness Study Prescription Area, also be unique to this alternative, would not contribute additional acreage to FOG. That land base would be removed from the Red River Gorge acreage, already considered FOG. Active management for viability reasons would occur on about 70,000 acres of the large Custodial Prescription Area. These stands would be classified as suitable for timber production and likely would not qualify as FOG.

All major forest types are currently represented across these Prescription Areas, but upland communities would be unlikely to reach and maintain old-growth status. Direction provided in this alternative would discourage the prescribed burning and thinning required to perpetuate these oak and yellow-pine communities. Thus, most of the acreage mentioned above would eventually succeed to mixed mesophytic hardwood species, white pine or eastern hemlock.

This alternative would not include a Designated Old-Growth Prescription Area that could promote the enhancement of upland communities, but it would call for some yellow pine restoration. About 4,300 acres of yellow pine seedlings would be planted every decade for the next eight decades.

About 2,200 acres would be restored to pine woodland or pine wooded grassland/shrubland while the rest would become forest with a much greater density of trees per acre. Therefore, even though these acres would not be managed or protected as old-growth, most stands could reach at least 100 years of age, the defined minimum age for old-growth xeric pine and pine-oak forest and woodland (USDA Forest Service 1997b).

Table 3 - 28. Acres of *future* old-growth (FOG) by community, in those Prescription Areas common only to Alternatives B-1, C, C-1, D, and E-1.

Prescription area[1]	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic Oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland[2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Uninventoried acres	Beech (totals included in mixed mesophytic forest)	Total acreage
1.E. Riparian corridor	7,085	34,925	2,296	49,631	4,281	13,944	10,557	142	5,063	1,583	127,924
5.C. Source water protection	317	1,533	1	1,990	1,841	1,144	501	0	9	0	7,336
Totals	7,402	36,458	2,297	51,621	6,122	15,088	11,058	142	5,072	1,583	135,260

[1]Prescription Areas overlap. The totals in columns reflect acreages that remain after the overlap has been removed. Overlapping acres have been included in the most restrictive Prescription Area.

[2]These acres have not been re-evaluated following the southern pine beetle epidemic, and may now have a severely diminished yellow pine component.

With the lack of a Designated Old-Growth Prescription Area, no areas would be managed specifically for sixbanded longhorn beetle habitat. Across the Forest, in prescription areas that are FOG, over 2,600 acres have been identified in the Continuous Inventory of Stand Condition as beech/sugar maple stands. However, minimal management within the Forest (not just in Prescription Areas that are FOG) under this alternative should lead to a substantial increase in habitat for the beetle. Beech and sugar maple trees should increase over time in mixed mesophytic stands as well as on dry sites as shade-tolerant species die out. Other species that require interior habitat should benefit unless they require large unbroken areas of upland interior habitat in particular.

ALTERNATIVES C, C-1, AND D

Under any of these three alternatives, identical land bases (Table 3 - 27 and Table 3 - 28) would provide *future* old-growth. The FOG acreage would total about 256,000 acres.

Alternatives C, C-1, and D also include a Designated Old-Growth Prescription Area, which would move over 270,000 acres toward old-growth conditions. Within the Designated Old-Growth Prescription, tracts would be managed specifically to promote the communities typically found prior to the era of fire exclusion. Prescribed fire would be a primary tool to promote upland old-growth communities. In other communities, where the historic fire regime has not been altered as extensively, prescribed fire would be less important.

The Designated Old-Growth Prescription Area was developed to provide at least eight percent representation of the eight old-growth communities types on the Forest, with corresponding old-

growth conditions (USDA Forest Service 1997b) and associated species. About 15,300 acres within nine distinct units are found in this Prescription Area (Table 3 - 29). It should be remembered that acres classified by CISC as xeric pine or pine/oak most likely have been affected by the southern pine beetle epidemic. Therefore, they may in reality exist as dry and dry-mesic oak/pine, or dry-mesic oak.

Table 3 - 29. Acres of Designated Old-Growth by district, unit, and community, including acres of openings, in Alternatives C, C-1 and D.[1]

District	Old-Growth unit	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic oak forest and woodland	Dry and xeric oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak [2]	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Beech (totals included in mixed mesophytic forest)	Total forested acreage per old-growth unit	Acres of openings	Total acreage per unit
Morehead	Yocum Cr.	39	783	29	587	112	43	171	0	0	1,763	143	1,906
	Caney Cr.	0	86	21	1,506	72	189	595	0	0	2,468	85	2,552
Stanton	Cave Hollow	0	293	0	436	0	0	184	0	0	913	0	913
	Claw Tract	0	278	0	48	0	0	0	0	68	325	0	325
London	White Oak Cr.	353	95	0	1,398	93	202	21	0	0	2,162	0	2,162
	Horselick Cr.	6	1,020	51	567	87	223	15	43	56	2,012	5	2,017
Somerset	Straight Creek	0	381	0	543	0	223	88	0	47	1,235	0	1,235
Stearns	Jellico	0	966	0	783	413	41	0	0	46	2,203	100	2,303
Redbird	Big Double Cr.	47	1,239	108	446	0	0	0	23	589	1,863	55	1,918
	Total	445	5,141	209	6,314	776	920	1,074	66	806	14,944	388	**15,331**

[1]This prescription area is found in all alternatives, but only the Claw Tract would be incorporated in the prescription area in Alt. E-1.

[2]These acres have not been re-evaluated since the southern pine beetle epidemic; their yellow pine component may be severely diminished.

In the Designated Old-Growth Prescription Area, CISC identified about 800 acres of beech/beech-sugar maple within the approximately 4,300 acres of the mixed mesophytic forest type. Currently, 90 percent is older than 70 years. No forest type on the DBNF qualifies as old-growth at 70 years, but the distinction between age classes older and younger than 70 years highlights possible management changes over time.

Land purchases for establishment of the DBNF began about 70 years ago. The government purchased many tracts that had been logged by their former owners in the 1930s or earlier. Other tracts were purchased over the last 70 years, but the former owners first harvested timber from them. Most remaining stands were logged after being acquired by the Forest Service.

Some stands have been identified as *possible* old-growth, even if they are second growth. None have been field-inventoried to confirm that they are in fact old-growth. Over time, all stands can meet the three old-growth criteria (age class, basal area, and diameter at breast height of the largest trees), and

most will show decreasing presence of the human disturbances that are inconsistent with old-growth attributes.

The Designated Old-Growth Prescription Area has been sorted by age classes in Table 3 - 30.

A) Minimum old-growth age (POG)

Because the minimum old-growth age criteria varies by forest type (e.g., conifer northern hardwood at 140 years and river Floodplain hardwood at 100 years) (Table 3 - 25), stands as young as 100 years for specific forest types were placed into this category. Only about two percent of the Designated Old-Growth Prescription Area meets the minimum old growth age criteria and was identified as *possible* old-growth. However, across the entire forest, regardless of Prescription Area, few stands are at least 100 years old.

B) Stands 0-70 years old

Some of these stands were logged after being acquired by the Forest Service. The remaining stands were logged by former owners and have been acquired by the DBNF within the previous 70 years. About one-fourth of the Prescription Area is in this age group.

C) Stands older than 70 years but not yet within minimum old-growth age

These are stands that have not been harvested since being incorporated into the DBNF but are not yet old enough to qualify as *possible* old-growth. Some of these stands may have been thinned but the overstory was not completely removed. Close to three-fourths of this Prescription Area is in this age group.

Table 3 - 30. The Designated Old-Growth Prescription Area sorted by stand age class, community, and acres.

Stand age class	Conifer northern hardwood forest	Mixed mesophytic forest	River floodplain hardwood forest	Dry-mesic oak forest and woodland	Dry and xeric Oak forest, woodland, wooded grassland/shrubland	Xeric yellow pine and yellow pine-oak forest, woodland and wooded grassland/shrubland	Dry and dry-mesic oak-pine forest and woodland	Eastern riverfront forest	Beech (totals included in mixed mesophytic forest	Total acreage per age class
A	0	0	13	0	43	43	92	0	0	191
B	169	1,607	53	1,077	68	490	257	56	66	3,777
C	246	3,534	143	5,237	665	387	725	10	740	10,937
Unknown	31							10		41
Total	446	5,141	209	6,314	776	920	1,074	66	806	14,946

[1] Stand Age Classes:

A) Minimum old growth age (POG) stands. The age at which a stand qualifies for old-growth varies by forest type and is based on criteria in USDA Forest Service 1997b. See Table 3 - 25 for a summary.

B) Stands 0-70 years old.

C) Stands more than 70 years old but not old enough to qualify as old-growth. See Table 3 - 25 for summary of qualifying age criteria.

A query run in the CISC database helped determine the type and total acreage of openings within the designated old-growth units (Table 3 - 31). Larger openings (particularly those caused by humans) with a large amount of edge, and those in which the resulting land use is quite different from the surrounding forest, may decrease the capability of the unit to function as ecologically sound old-growth (functional old-growth, versus an area of "old trees"). Overall, three percent of the Prescription Area is in openings such as utility, road and railroad rights-of-way, strip mines, water bodies (from ponds to impoundment backwaters), and grassy openings, and those maintained for special uses (Table 3 - 32).

Table 3 - 31. Amount and percentage of openings that occur in old-growth units within the Designated Old Growth Prescription Area.

District	Old-Growth unit	Unit size (acres)	Amount of forested land (acres)	Amount of openings (acres)	Percent of unit in openings
Morehead	Yocum Cr.	1,906	1,763	143	8
	Caney Cr.	2,552	2,468	85	3
Stanton	Cave hollow	913	913	0	0
	Claw Tract	325	325	0	0
London	White Oak Cr.	2,162	2,162	0	0
	Horselick Cr.	2,017	2,012	5	<1
Somerset	Straight Creek	1,235	1,235	0	0
Stearns	Jellico	2,303	2,203	100	5
Redbird	Big Double Cr.	1,918	1,822	55	3
	Total	15,331	14,903	388	3

Table 3 - 32. Description of non-forest openings that occur in old-growth units within the Designated Old Growth Prescription Area.

Old-Growth unit	Type of opening	Number of openings	Acres
Yocum Cr.	Grassy opening	3	73.6
	Water	1	69.7
	Total	4	143.3
Caney Cr.	Right-of-way	1	11.3
	Grassy opening	5	21.7
	Water	4	51.5
	Total	10	84.5
Horselick Cr.	Right-of-way	2	5.0
	Total	2	5.0
Jellico	Strip Mine	1	94.2
	Grassy opening	1	6.0
	Total	2	100.2
Big Double Cr.	Special use	2	18.9
	Strip mine	1	17.4
	Right-of-way	1	1.2
	Grassy opening	1	17.2
	Total	5	54.7
	Grand total	23	387

Alternatives C, C-1, and D include the 1.K. Habitat Diversity Emphasis Prescription Area in which the creation and perpetuation of mature open pine and oak communities would be encouraged. In the first decade, about 8,200 acres of yellow pine seedlings would be planted to begin restoration of that community type. Within the next seven decades, an additional 33,000 acres would be scheduled for planting. These stands would replace the pine and mixed pine-hardwood forests decimated by the southern pine beetle. In the long term, they would likely meet or exceed 100 years of age, the defined minimum for old-growth xeric pine and pine/oak forest and woodland (USDA Forest Service 1997).

The Desired Future Condition of the Habitat Diversity Emphasis Prescription Area calls for the creation and maintenance of between 120,000 and 160,000 acres of fire-mediated habitat. (The timeframe for the creation of this habitat depends on prescribed burning and other management levels.) Stands will reach the minimum age of old-growth prior to harvest and regeneration. In fact, this rotation is a long-term objective for the area, providing network connectivity for the old-growth community.

In the Habitat Diversity Emphasis Area old-growth characteristics would not necessarily be emphasized. Roads, trails, and human manipulation and presence could become common across the landscape. Therefore, the Designated Old-Growth Prescription Area remains important because it provides specific areas that would be managed for the purpose of establishing and maintaining old-growth conditions, as defined by tree and stand characteristics, including disturbance levels. Only

the Designated Old-Growth Prescription Area will have that management strategy throughout the duration of the 2004 Forest Plan.

The old-growth conditions provided within any of these three alternatives would increase the potential for functional old-growth, at least 300 acres in size. Compared to Alternatives A, B-1, or E-1 they also would increase the chances of upland communities (dry-mesic oak; dry and xeric oak; xeric yellow pine and yellow pine/oak; and dry and dry-mesic oak/yellow pine forests) remaining in a fire-mediated seral stage. Prescribed burning and thinning would be permitted and encouraged to enhance these communities within the Designated Old-Growth Prescription Area. Without these management techniques, most of the yellow pine and oak communities would succeed to shade-tolerant hardwoods and possibly white pine and hemlock.

ALTERNATIVE E-1

As in the other alternatives, Prescription Areas involving little vegetative manipulation will move them by default toward Future Old-Growth (Table 3 - 27 and Table 3 - 28). These areas would be identical to those in Alternatives C, C-1, and D.

Under this alternative, the Designated Old-Growth Prescription Area would exist, but only the Claw Tract would be included (Table 3 - 29), at least initially. Other distinct units could be added to the Designated Old-Growth Prescription Area as a result of POG surveys or for other reasons.

The Claw Tract is included because it is within the Stanton Ranger District, the only district on which the sixbanded longhorn beetle has been found. Adequate beech/sugar maple habitat would be provided for the beetle between this unit (which has about 70 acres of beech/sugar maple), 1,500 acres of beech found within the Riparian-Aquatic protection area, and 1,100 acres in the other Prescription Areas that are FOG across the six districts.

The sixbanded longhorn beetle is the only species on the forest that appears to depend on old-growth for habitat. In this alternative, vegetation manipulation for biological diversity's sake would be limited mostly to that required by the National Forest Management Act. No other forest type needs to be maintained in an old-growth condition to provide for the viability of any species.

However, about 4,300 acres of yellow pine seedlings would be planted every decade for the next 80 years to meet other viability requirements. A total of about 2,200 acres would be restored to pine woodland or pine wooded grassland/shrubland, and the rest will become forest (70+ basal area), which has a much greater density of trees per acre. The stands would be maintained with prescribed fire. These acres would not be managed for, or protected as old-growth, but most could reach at least 100 years of age, the defined minimum for old-growth xeric pine and pine/oak forest. (USDA Forest Service 1997b).

Old-growth conditions would be unlikely in any Prescription Areas or situations other than those described above. Additional thinning and prescribed burning to ensure maintenance of fire-mediated seral stages would likely be minimized. The largest Prescription Area in this alternative would be the Timber Production Emphasis area at nearly 395,000 acres. Old-growth management would conflict with strategies that emphasize timber production. Therefore, little, if any, of the forest in this or the remaining Prescription Areas would be likely to reach old-growth conditions.

CUMULATIVE EFFECTS COMMON TO ALL ALTERNATIVES

The incremental effects of other federal, non-federal, or private actions would not change, regardless of alternative. Any difference in cumulative effects would be reflected in the differences of an alternative's direct and indirect effects.

Within and adjacent to the DBNF proclamation boundary, the management of other public lands (Big South Fork NRRA; and Natural Bridge, Cumberland Falls, and Buckhorn Lake State Parks) is moving them toward an old-growth condition. These four parks add an additional 35,000 acres to the *future* old-growth base. The remaining land surrounding the Forest is primarily private or corporate-owned forested land, residential areas, or small farms. Any non-federal forest is subject to harvest at any time and old-age forests are not necessarily afforded any protection.

Regardless of the alternative chosen, the land outside National Forest System ownership would not influence the proposed designation of old-growth. However, an increase in old stands within the Forest would benefit local species that use interior forest, as well as old or large trees, by increasing the prospects for inter-connecting areas of functional old-growth. Thinning and burning to promote oak and oak/yellow pine (and the few remaining yellow pine) communities is or would be conducted on a small scale within areas surrounding the Forest. Nor do other land management agencies with holdings within the proclamation boundary plan to plant seedlings in former yellow pine stands. Restoration of yellow pine by means other than natural regeneration would occur mainly on National Forest System land.

RARE COMMUNITIES

Affected Environment

The extent of concern for rare communities in these discussions is limited to the area within the Daniel Boone National Forest proclamation boundary. Within this boundary are found lands of private (individual and corporate), state, and federal ownership. Forest Service management activities, except for land acquisition, would occur only on National Forest System land.

Rare communities are so called for a variety of reasons. Distributional rarity and conditional rarity are the traits that contribute most to recognition of rare communities on the DBNF. Distributionally, rare communities are usually tied to specific physical characteristics on the landscape. While such communities may be found scattered across large regions at varying densities, they are isolated on the landscape. A community may also be rare in a particular area, such as at the edge of its identified range, but otherwise frequent-to-common throughout its known distribution. Conditional rarity is related to the current vegetation structure of any habitat association. For example, a fire-mediated or fire-dependent community may be exceptionally rare in an area because long-term fire absence has drastically changed landscape conditions. With the introduction of fire in this case, the locally rare community could again become widespread and common. Distribution and condition can work together to influence rarity.

Few rare communities were recognized or documented until the DBNF participated in cooperative rare-species inventories (USDA Forest Service et. al. 1988-1994). During these inventories, many rare communities were discovered, and several have been located since. Some rare communities known to exist on the Forest are not yet organized in a spatial or tabular database, as much of the information acquired during the inventories was mapped at a gross scale showing large areas rather than specific rare communities. Table 3 - 33 shows the indicators used to evaluate this resource:

- Community names
- Number of known sites
- Estimated known acreage for each community type
- Estimated total acres around and including sites that would be managed.

The latter category is shown under “management acres” and includes the area around some rare communities in which management activities are conducted for the benefit of the community. The last column displays the nature of the rarity for the community on the DBNF.

An additional set of indictors is related to the management emphasis of a particular alternative. The combination of likely efforts to enhance rare communities, not just protect them, and the likely occurrence of unintended damage from dispersed recreation are considered. The lack of firm measures for either of these indicators requires the use of relative, rather than definite, levels of measurement.

RESOURCE TABLE

Table 3 - 33. Rare communities found on the DBNF, including the number of sites, estimate of community size and the number of surrounding acres managed to address or benefit the rare community.

COMMUNITY NAME	Number of Known Sites	Estimated Size (acres)	Management Area (acres)[1]	Rarity Type[2]
Streamhead Seeps/Bogs	60	5	1000	Distribution/Condition
Slope Seeps	10	5	Included above	Distribution
Swamps	2	4	80	Distribution
Natural Ponds	8	2	80	Distribution
Limestone Glades	4	2	8	Distribution/Condition
Sandstone Glades	6	15	30[4]	Distribution/Condition
Spray Cliffs	6	2	100[4]	Distribution
Canebrakes	10	8	16[5]	Distribution/Condition
Native Warm-season Grasslands	ca. 30	50	50[6]	Distribution/Condition
Wet Meadows	1	4	4	Distribution
Cedar Glades	ca. 5	80	80[7]	Distribution/Condition
Cedar-grass Woodland[3]	1-2	20-30	40	Distribution

[1]An estimate of the total acres around and including the sites for which management activities specifically address or benefit the rare community.

[2]Rarity Type: Distribution = sites that occur because of physical landscape features which themselves are rare; Condition = sites that are rare because of a dependence on a vegetative structure which may be created or maintained by active management within a habitat association

[3]These figures are estimates. This community is known to occur near the DBNF and undocumented sites may exist within the DBNF.

[4]Sites usually are found within the Cliffline Community Prescription Area.

[5]Sites usually are found within the Riparian Corridor Prescription Area.

[6]Sites usually are found within the Habitat Diversity Emphasis Prescription Area.

[7]Approximately 50 acres are found within the Cliffline Community Prescription Area.

Community Descriptions

Streamhead Seeps/Bogs are naturally occurring (rarely induced by human action) wetlands associated with low-order streams. As the name implies, they usually occur near the head of streams, usually 2nd and 3rd order. These are areas of boggy soils and vegetation formed in saturated pockets of sand. They are supplied water by both the stream and ground water seeps at geologic contact zones along the stream channel. Water flows perennially in these sites, although at times it is low-rate subsurface flow. Vegetation is dominated by herbaceous species with sphagnum moss species often dominant. Trees and shrubs may be present, usually at the margin or on hummocks. Fire may have a role in the maintenance and enhancement of these communities. These sites harbor many rare or uncommon species, such as white fringeless orchid and ginger-leaved grass of Parnassis. The numerous crayfish that inhabit these sites may include undescribed species. The sites are sensitive to changes in water flow, especially changes in surface water flow.

Slope Seeps are naturally occurring wetlands associated with extensive geologic contact zones. Low-order streams are generally located down slope, but drain, rather than feed, these wetlands. Like streamhead seeps and bogs, these areas are boggy, formed on saturated soils. Water flows

perennially in these sites, although at times, it is low-rate subsurface flow. Vegetation is dominated by herbaceous species with sphagnum moss species often dominant. Trees and shrubs may be present. Fire may have a role in the maintenance and enhancement of these communities. These sites harbor many rare or uncommon species, such as the caric sedge *Carex seorsa*, and the liverwort *Telaranea nematodes*.

Swamps are naturally occurring wooded wetlands. They are characterized by standing water throughout the year (some drying may occur in drought years) with the presence of trees tolerant of flooding. They form in depressions where clay layers prevent seepage of water out of the area. Swamps are found in upland and floodplain positions. Water may come from flooding, stream inflow, or ground water sources. Trees dominate the vegetation, but tufts of emergent herbaceous species are common. These harbor many rare or uncommon species such as the uptight caric sedge.

Natural Ponds are naturally occurring water bodies. On the DBNF, they occur along ridgetops, usually on those capped by sandstone. They can appear as old farm ponds, usually with trees growing in or at their edges. Frequently, the buttonbush shrub is found in these ponds. Ponds may harbor rare or uncommon species such as pond caric sedge. Several of these ponds have yielded pollen and charcoal records from bottom sediments. However, dredging or fill over the last 200 years has altered many of these ponds. Many retain water throughout the year, except in drought years, but some regularly dry out.

Limestone Glades are naturally occurring areas (rarely induced by human action) of thin soil on limestone cliffs or outcrops. Tree growth is absent or severely stunted, although shrubs may be present. Vegetation dominated by herbs, usually grasses and sedges, is often sparse. Most glades are dry, but they can have seeps associated with them. Infrequent, low intensity fire may play a role in maintenance and enhancement. They harbor rare or uncommon species such as mountain lover and nettleleaf noseburn.

Sandstone Glades are naturally occurring areas of thin soil on sandstone cliffs or outcrops. Tree growth is absent or severely stunted, although low shrubs are commonly present. Vegetation is dominated by low shrubs or herbs, and may be sparse. Most glades are dry, but they can have seeps associated with them. Infrequent, low intensity fire may play a role in maintenance and enhancement. They harbor rare or uncommon species such as fameflower and box huckleberry.

Spray Cliffs are naturally occurring areas (rarely induced by human action) found at and adjacent to waterfalls. They are zones of high humidity, constant moisture, and cool temperatures created by waterfall spray. Portions of the cliff are often shaded, further enhancing moist, cool conditions. Spray cliff zones harbor many rare or uncommon species such as little mountain meadow rue and sword moss.

Canebrakes are naturally occurring grasslands or wooded grasslands dominated by a variety of cane, a native bamboo. They are usually dense and once extended for tens of acres. Canebrakes are usually associated with river flood plains (river cane form), but also occur on uplands (hill cane form). Many of the canebrakes on the forest are in poor condition, and all are small. Cane itself is somewhat uncommon on the DBNF. Periodic fire helped maintain these communities. Canebrakes may once have been primary habitat (Brantley and Platt 2001; Trani-Griep 2002) for the uncommon Swainson's warbler.

Native Warm-season Grasslands usually occur naturally (as opposed to areas created by human action). These grasslands, dominated by warm-season grasses, may occur on roadsides, in utility corridors, or as forest openings. Many of these areas are edaphically controlled, but most are maintained by periodic fire. Historically, they were associated with burned yellow pine, upland oak and mixed oak-yellow pine woodlands, occurring as open areas between clusters of trees, i.e., in wooded grasslands, woodlands, or as the understory in open forest. Today, they exist as isolated pockets of vegetation, often no longer in the context of fire maintained or enhanced woody plant communities. In the grassland areas, trees are usually absent, although small shrubs and saplings may be found in sites of poorer condition. These areas are generally small, often less than one-quarter acre, but occurrences can be up to 20 or 30 acres in size. Native warm-season grasslands provide habitat for many rare or uncommon species such as royal catchfly and yucca-leaved rattlesnake master. In conjunction with woodland, they provide habitat for uncommon species such as eastern slender glass lizard and Diana fritillary.

Wet Meadows are native communities associated with fragipan soils or ground/surface water sources that maintain moist to wet soils through most of the year. Cool-season grasses (some warm-season may be present), sedges and rushes dominate the vegetation. Various forbs are present. Woody plants are generally few, primarily small shrubs. Wet meadows often associated with river flood plains, may occur on broad toe slopes and ridges. They provide habitat for rare or uncommon species such as grass-pink and if large enough sedge wren.

Cedar Glades are naturally occurring communities associated with usually dry limestone outcrops and cliffs. On the DBNF, most are along ridgetops, but at least one is on a limestone slope. The sites are rocky with thin soil. Eastern redcedar is often the dominant woody species, but past management may have diminished redcedar, allowing oaks and ashes to dominate. The canopy may be open with either a grass-forb or shrub dominated understory. Closed canopies often have sparse understories with extensive thickets of catbrier and sawbrier. Infrequent, low-intensity fire may be important in the maintenance of these communities. The open canopy condition provides habitat for many rare or uncommon species such as mountain lover and Harris's goldenrod.

Cedar Woodlands/Grasslands here are defined as a naturally occurring mosaic of eastern redcedar and predominately native grass-sedge patches. The communities often appear as overgrown abandoned fields but are dominated by native species. These communities occur on siltstone (rarely other calcareous substrates including mudstone and limestone) slopes. Generally dry, a combination of infrequent fire and edaphic conditions help maintain these community sites. Herbivory by large ungulates (grazing by large, hoofed mammals) may have occurred in the past. This community type is known in Bath County, but has yet to be documented on the DBNF. This community type is known to provide habitat for the rare Juniper sedge. This community is listed here since there is some possibility it occurs on the forest, and there is a need to recognize the community. The number of sites and acres are estimates of potential occurrence. Additionally, juniper sedge occurs more frequently in an oak dominated variant of this community type at the southern edge of its range (Naczi and Ford 2001). This community variant is included here if it occurs with juniper sedge.

Environmental Effects

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Known rare communities affected by implementing Alternative A are shown in Table 3 - 33. From a programmatic view, this alternative would allow for the direct protection and enhancement of rare communities, but would not specifically direct such action. Alternative A does not specifically identify rare communities by type for specific management, but neither does it prevent such identification. The effect of implementing this alternative could include inadvertent damage to communities not recognized or identified in site-specific analysis and missed opportunities to improve conditions within those communities. Given the emphasis of Alternative A, the number of actual existing sites may not be discovered. This in turn affects the actual number of acres managed for rare community values. Relative acres of communities that are rare due to distribution or condition are likely to remain as currently known. The current condition reflects action under the 1985 Plan (represented by Alternative A) for the last 10 years. The relative levels of management for rare communities and inadvertent damage from dispersed recreation are expected to remain near current levels, which also reflects management action for the last 10 years. Also, in site-specific projects, the relationship of specific community locations and conditions to other, similar sites on the forest could be overlooked.

CUMULATIVE EFFECTS

Some protection and management of rare communities would occur under this alternative during site-specific project analysis and implementation. Rare communities would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue with development likely on many more private lands that contain rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of rare communities would be decreased. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of such communities on National Forest System land would at least help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is intended primarily to protect, rather than actively maintain, rare communities. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, where habitats are maintained for the specific values desired in each rare community, the likelihood of the communities remaining on the landscape for the long-term would increase. The communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and specifically identify rare communities by type for specific management. From a programmatic view, Alternative B-1 should support the continued existence and health of these communities, although only at a minimal level. Management activities prescribed in this alternative should help maintain conditions within all rare communities, but may only enhance some of them. However, given the emphasis of the alternative, all existing sites may not be discovered. Identification will determine the acreage to be managed for rare community values. Relative acres of communities, rare due to distribution or condition, would likely to remain stable, although a small decrease in rarity due to condition could occur as some rare community enhancement is expected. The relative level of management for rare communities is expected to increase slightly over the current condition, primarily in the form of recognition of specific community types and appropriate management action to maintain sites. Inadvertent damage from dispersed recreation is expected to decrease from the current condition as dispersed recreation decreases. National Forest System land included in the Rare Communities Prescription Area and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative B-1. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency action often proceeds without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue, with the likely development of many more areas of private lands that contain rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of the communities is decreased or conditions within them become less favorable for maintaining the community, and they become more rare. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally designed only to protect rare communities, not maintain or enhance them. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community. Doing so would increase the likelihood of sustaining these communities on the landscape for the long-term. Rare communities generally occupy rather different locations or conditions on the landscape and do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and specifically identify rare communities by type for management. From a programmatic view, Alternative C should support the continued existence and health of these communities, not only maintaining, but also enhancing conditions within all or most rare communities. Given the emphasis of this alternative, the actual number of existing sites is more likely to be discovered than in other alternatives. Identification would determine the actual number of acres to be managed for rare community values. Relative acres of communities, rare due to distribution, may decrease or remain stable depending on the community. If conditions within rare communities improve, a decrease in the number of those rare due to condition would be expected. The relative level of management for rare communities could be expected to increase above current conditions as specific community types are recognized and appropriate management action is taken to enhance these communities. Inadvertent damage from dispersed recreation can be expected to remain stable. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative C. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency action often proceeds without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on property that included many of these communities. Growth along the I-75 corridor is expected to continue, with the likely development of many more areas of private lands that contain rare community elements. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect, rather than actively maintain, rare communities. With time, protection alone may result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats are maintained for the specific values desired in each rare community. Doing so would increase the likelihood of sustaining these communities on the landscape for the long-term. The communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and expressly identify rare communities by type for specific management. From a programmatic view, Alternative C-1 should support the continued existence and health of these communities. Favorable conditions within all or most rare communities would be enhanced, not just maintained. Given the emphasis of this alternative, the actual number of existing sites is more likely to be discovered. Identification determines the number of acres to be managed for rare community values. Relative acres of communities, rare due to distribution, may decrease or remain stable depending on the community. As conditions within rare communities improve, the number of those rare due to condition can be expected to decrease. The relative level of management for rare communities can be expected to increase beyond the current condition primarily through recognition of specific community types and appropriate management action to enhance these communities. Inadvertent damage, such as trampling and alteration of hydrology, from dispersed recreation would be expected to increase as dispersed recreation levels rise. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under Alternative C-1. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered the quality or uses of property that included many of these communities. Growth along the I-75 corridor is expected to continue with the likely development of private lands that contain rare community elements. New land uses could also render locations less favorable to rare community elements, increasing their rarity. Management of these communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park lands within the proclamation boundary. Management on these lands, however, is generally designed to protect, rather than actively maintain, rare communities. With time, protection alone could result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community, and they would be more likely to endure over the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription Area and expressly identify rare communities by type for specific management. From a programmatic view, Alternative D should enhance conditions favorable to rare communities, not just maintain them. Given the emphasis of this alternative, existing rare community sites are more likely to be discovered. Actual acreage helps determine management for rare community values. Relative acres of communities, rare due to distribution, could decrease or remain stable depending on the community. As conditions within rare communities improve, the number of those rare due to condition is likely to decrease. The relative level of management for rare communities would be expected to increase primarily through recognition of specific community types and appropriate management action to enhance them. Inadvertent damage, such as trampling and alteration of hydrology, from dispersed recreation could be expected to increase as dispersed recreation levels rise. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would expressly afford protection and management under this alternative. They would have a greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered the qualities or uses of lands that included many of these communities. Growth along the I-75 corridor is expected to continue with the likely development of private lands containing rare community elements. As these communities are altered or replaced by other land uses, the overall distribution of rare communities is decreased, or conditions within them become less favorable and they become more rare. Management of rare communities on National Forest System land would help ensure their continuance within the proclamation boundary. Some of these communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect, rather than actively maintain, rare communities. With time, protection alone could result in the loss of some rare community sites on state or other federal lands.

OTHER EFFECTS

In the short-term, these habitats would be maintained for the specific values desired in each rare community. Doing so should increase the likelihood of sustaining them on the landscape for the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

This alternative would include the Rare Community Prescription and expressly identify rare communities by type for specific management. From a programmatic view, Alternative E-1 should support the continued existence and health of these communities, although only at a minimal level. Management activities prescribed in this alternative should help maintain conditions within all rare communities, but may enhance only some of them. Given the emphasis of Alternative E-1, the exact number of existing sites may not be discovered. Identification determines the number of acres managed for rare community values. Relative acres of communities, rare due to distribution or condition, are likely to remain stable, although a small decrease in rarity due to condition may occur as some rare community enhancement is expected. The relative level of management for rare communities can be expected to increase beyond current conditions primarily through recognition of specific community types and appropriate management action. Inadvertent damage from dispersed recreation would likely increase because dispersed recreation can be expected to expand. National Forest System land included in this prescription and withdrawn from other primary management is estimated in Table 3 - 33.

CUMULATIVE EFFECTS

Rare communities would be expressly afforded protection and management under this alternative. They would have greater chance for survival on the DBNF than on surrounding private or state-owned lands where private and other agency actions often proceed without regard for rare communities. Private and corporate development adjacent to the Forest has altered land qualities or uses on land that included many of these communities. Growth along the I-75 corridor is expected to continue along with development of private lands containing rare community elements. As these communities are altered or replaced by other land uses, their overall distribution is decreased or conditions within them become less favorable, increasing their rarity. Management of these communities on National Forest System land would help ensure their existence within the proclamation boundary. Some rare communities occur on state or national park land within the proclamation boundary. However, management on these lands is generally to protect rather than actively maintain rare communities. With time, protection alone may result in loss of some sites on state land.

OTHER EFFECTS

In the short-term, these habitats are maintained for the specific values desired in each rare community. Doing so increases the likelihood of sustaining rare communities on the landscape for the long-term. Rare communities occupy rather different locations or conditions on the landscape and generally do not compete for the same spaces. Maintaining these areas as rare communities, however, would preclude other habitat uses.

VEGETATION COVER

Affected Environment

Most of the DBNF lies in the generally forested Northern Cumberland Plateau. A small area lies in the generally less forested eastern portions of the Mississippian Plateau along the western edge of the Northern Cumberland Plateau. Portions of the Northern Cumberland Plateau, especially at the transition into the Bluegrass and Mississippian Plateau and along large river bottoms, are frequently cleared for pasture or row crops. Areas within the coalfields of the plateau often have large deforested areas associated with mining. For analysis, this discussion is limited to the area within the DBNF's proclamation boundary. Land within the proclamation boundary is generally forested, but the western edge at the transition into the Bluegrass region and the Mississippian Plateau, and along large river bottom land in private ownership, is frequently cleared for pasture or row crops. Portions of land within the proclamation boundary are in extensive grassland following mining activities.

National Forest System land totals approximately 697,900 acres or about one-third of the approximately 2.1 million acres within the proclamation boundary. Three state parks (Natural Bridge State Resort Park, Cumberland Falls State Resort Park, and Buckhorn Lake State Resort Park) covering about 4,400 acres, the Big South Fork National River and Recreational Area covering about 31,350 acres, and the state managed Beech Creek Wildlife Management Area (WMA) occupying about 1,250 acres lie within the proclamation boundary. Individuals or corporations own the remaining land within the proclamation boundary, approximately 1,368,000 acres.

On the Daniel Boone, the Continuous Inventory of Stand Condition (CISC) database (USDA Forest Service 1997) provides an approximate record of forest type and age. The database also provides an approximate record of land not in forested condition. Figure 3 - 21 displays this information as recorded through 1997. National Forest System ownership includes approximately 17,230 acres of water surface or land that is subject to yearly seasonal flooding, mostly associated with the three large reservoirs within or bordering the forest. Another 3,930 acres are open lands associated with utility corridors, old surface mines, and road or railway rights-of-way. About 2,144 acres are classified as grassy openings. A more recent survey (USDA Forest Service 2002) indicates that this number is approximately 2,171 acres. The various forest association acres are found in Figure 3 - 21.

Beginning in late 1999, a severe southern pine beetle infestation drastically reduced the number of southern yellow pine (SYP) and SYP-hardwood forest acres found on the DBNF. The exact extent of change is not currently known, but current estimates suggest that only about 1,200 acres of SYP-dominated forest remain, most of which is between one and 10 years old. The area of hardwood-SYP forest has probably decreased about 17,500 acres. Individual yellow pine trees remain scattered across the forest, but usually not in enough concentration to qualify an area as either SYP-dominated or hardwood-SYP forest.

Other stochastic events, primarily storm events, which affect the composition and structure of vegetation on the landscape are expected to occur. Based on events over the last 15 years, it is estimated that about 7,000 acres (slightly more than 1 percent of the forested land area with the Daniel Boone National Forest) a decade, on average, will be put into condition similar to the 0-10 year old early-aged forest condition. This is described as less than or equal to 40 sq ft basal area of overstory trees and at least 200 well-distributed seedlings of tree species 10 or fewer years old. Management activities will take these areas into account when prescribing actions to meet desired

future conditions. Additional areas of forest not meeting the early-aged forest definition, but affected by stochastic events are also expected, with an estimate of up to 10,000 acres a decade on average. These areas may resemble heavy thinnings or consist of heavily damaged trees, and even have elements of early-aged forest, but do not fit the category of early-aged forest. Management actions will also take these into account.

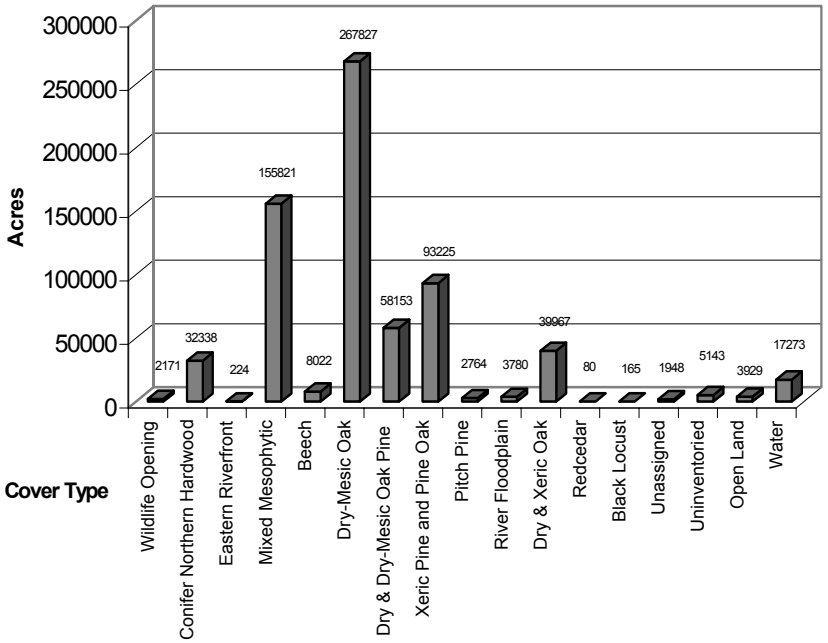

Figure 3 - 21. Acres of Habitat Association and non-forest land through 1997.

Forest age structure, based on 1997 data with age adjusted to year 2002, is presented in Figure 3 - 22. Current age class distribution is bi-modal with concentration of acres in ages between 11-40 years old and 61-110 years old. The current trend is towards generally older forest. There is a long, low tail in the older age classes, but about 2,163 acres are older than 150 years, and about 638 acres are older than 200 years. The oldest forest stands are between 230 and 240 years old (all hemlock-hardwood). Grassland acres are based on 2002 data. The restructuring of age classes following the death of yellow pine trees is estimated in this chart. About 36,200 acres of SYP-dominated forest is estimated to have been set back to the 1-10 year age class in an oak-SYP or oak-hardwood forest type. Most of these acres came from the 71-120 year old age group, but some came from the 11-70 year old age group. Table 3 - 34 below shows estimated acres for a variety of habitats over time for all alternatives.

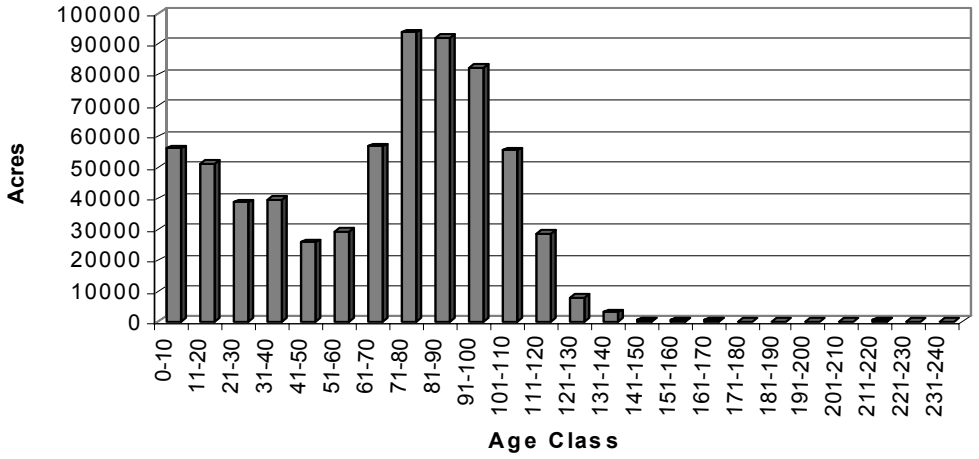

Figure 3 - 22. Acres By Age Class through 2002, adjusted for death of pine stands.

RESOURCE TABLE

Table 3 - 34. Acres[1] of Selected Terrestrial Habitat Types, Current, and by alternative. (Totals by decade).

CONDITION	2002	Decade[2]	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt E-1
Grassland	2171	1st	2271	900	2200	2200	2200	900
		2nd	2371	900	2200	2200	2200	900
		5th	2800	900	2200	2200	2200	900
Wooded grassland/shrubland (Pine)	0[3]	1st	0	110	110	110	110	110
		2nd	0	110	110	110	110	110
		5th	0	110	110	110	110	110
Wooded grassland/shrubland (Hardwood)	0[3]	1st	0	610	660	660	660	610
		2nd	0	640	1330	1330	1330	640
		5th	0	640	11424	11424	11424	640
Woodland (Pine)	0[3]	1st	0	362	100	100	100	362
		2nd	0	500	100	100	100	867
		5th	0	500	500	500	500	1396
Woodland (Hardwood)	0[3]	1st	0	2871	5570	5570	5570	2871
		2nd	0	2871	25273	25273	25273	2871
		5th	0	2871	39632	39632	39632	2871
Forest, 60-70 BA overstory	500[4]	1st	15000	1825	9000	9000	9000	23986
		2nd	15000	1925	8000	8000	8000	21137
		5th	15000	1825	8000	8000	8000	21635
Riparian (prescription) land only	N/A	1st	N/A	138800	138800	138800	138800	138800
		2nd	N/A	138800	138800	138800	138800	138800
		5th	N/A	138800	138800	138800	138800	138800
Riparian (100 year floodplain)[6]	100,000	1st	100,000	100,000	100,000	100,000	100,000	100,000
		2nd	100,000	100,000	100,000	100,000	100,000	100,000
		5th	100,000	100,000	100,000	100,000	100,000	100,000
0-10 year old Yellow Pine (restoration)	1200	1st	20830	4363	8216	8216	8216	4363
		2nd	35259	8726	16232	16232	16232	8726
		5th	46799	21797	40320	40320	40320	21810
Cliff zone (mixed forest types)	110843	1st	110843	110843	110843	110843	110843	110843
		2nd	110843	110843	110843	110843	110843	110843
		5th	110843	110843	110843	110843	110843	110843
Pitch pine	0[5]	1st	0	1000	1000	1000	1000	1000
		2nd	0	2000	2000	2000	2000	2000
		5th	0	3000	3000	3000	3000	3000
Beech	8022	1st	8022	8022	8022	8022	8022	8022
		2nd	8022	8022	8022	8022	8022	8022
		5th	8022	8022	8022	8022	8022	8022

CONDITION	2002	Decade[2]	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt E-1
Hemlock/white pine	21389	1st	21389	21389	21389	21389	21389	21389
		2nd	21389	21389	21389	21389	21389	21389
		5th	21389	21389	21389	21389	21389	21389
Conifer Northern Hardwood	11986	1st	11986	11986	11986	11986	11986	11986
		2nd	11986	11986	11986	11986	11986	11986
		5th	11986	11986	11986	11986	11986	11986
Mixed Mesophytic	147980	1st	147980	147980	147980	147980	147980	147980
		2nd	147980	147980	147980	147980	147980	147980
		5th	147980	147980	147980	147980	147980	147980
Dry Mesic Oak	268291	1st	322001	322001	322001	322001	322001	322001
		2nd	316549	322001	322001	322001	322001	322001
		5th	316549	316549	316549	316549	316549	316549
Dry Xeric Oak	40030	1st	40030	40030	40030	40030	40030	40030
		2nd	40030	40030	40030	40030	40030	40030
		5th	40030	40030	40030	40030	40030	40030
Dry Mesic Pine Oak	65292	1st	51148	59341	59341	59341	59341	59341
		2nd	40707	56532	56532	56532	56532	56532
		5th	40707	56532	56532	56532	56532	56532
Dry Xeric Pine Oak	30813	1st	24872	28004	28004	28004	28004	28004
		2nd	18931	25195	25195	25195	25195	25195
		5th	18931	25195	25195	25195	25195	25195
0-10 year old forest	56171	1st	50000	7000	22279	22279	22279	36364
		2nd	50000	7000	22279	22279	22279	36364
		5th	38240	7162	21519	21519	21519	36364
11-50 year old forest	155361	1st	185941	185941	185941	185941	185941	185941
		2nd	196360	153360	168640	168640	168640	182724
		5th	180413	77326	89116	89116	89116	145456
61-130 year old forest	416669	1st	388037	430317	414988	414988	414988	400953
		2nd	334976	420133	388978	388978	388978	361498
		5th	237007	320470	283764	283764	283764	262729
151-200 year old forest	1436	1st	1958	1958	1958	1958	1958	1958
		2nd	4853	4853	4853	4853	4853	4853
		5th	69297	90267	78474	78474	78474	68982
200+ year old forest	722	1st	789	789	789	789	789	789
		2nd	964	964	964	964	964	964
		5th	1520	1520	1520	1526	1526	1526
Mast-producing forest (51-200 year old oak)	212422	1st	200894	220807	213587	213587	213587	206977
		2nd	195903	236012	221338	221338	221338	208395
		5th	208392	294160	253836	253836	253836	225387

[1]1997 data adjusted for age as of 2002.

[2]Acres presented are per decade totals, except woodland and wooded grassland/shrubland acres, which are cumulative totals.

[3]These are presumed 0 acres. There may be some areas with similar structural characteristics on the ground at present as a result of the southern pine beetle infestation, but they are unlikely to have had fire applied to develop herbaceous and low shrub layers.

[4]This figure is an estimate. This condition was not commonly achieved during the last 10-15 years, and was not generally tracked when accomplished.

[5]The model used to account for yellow pine loss on the forest assumed almost total loss. This is unlikely to be the case. It is not known at present how much yellow pine, including pitch pine, remains on the DBNF.

[6]Acres estimated using a DEM model through GIS.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Direct and indirect effects on forest community and age structure from implementation of the 2004 Forest Plan direction vary by alternative. Based on projected conditions over the next five decades, the expected changes in community and age structure for each alternative are presented below. In each case it is assumed that most stand regeneration would occur in stands at least 61 years old, where the age class is represented by at least 32,000 acres across the Forest. This tends to focus management activity in the older concentration of acres in each of the five decades.

The effect of each alternative on forest age and community structure in turn affects management indicator species (MIS), especially terrestrial species. Vegetative condition (age, structure, composition) determines the available habitat for terrestrial MIS and other species. Descriptions of effects on terrestrial MIS are included for each alternative. In all cases, alternatives are assumed implemented as planned and are compared to existing conditions as reflected in the Continuous Inventory of Stand Condition as well as estimates of habitat changes following the southern pine beetle epidemic.

The effects on two MIS would be similar for all alternatives. The pine warbler, which is dependent on older southern yellow pine (70-80+ years), would not be provided for in the first five decades. However, all alternatives would provide for the species in the long-term, 7 to 8 decades from implementation. Regardless of alternative, the pine warbler species may persist in low numbers in remaining pockets of older yellow pine. Northern bobwhite quail, currently in low numbers associated with grasslands and open, burned yellow pine or yellow pine-oak forest on the DBNF is expected to be found more abundantly in open, grassy southern yellow pine or mixed yellow pine-oak woodland and wooded grassland. This species would not be provided for in the first four decades. But in the long-term, 5 to 7 decades from implementation, all alternatives would provide some habitat for the species. In any case, northern bobwhite quail may persist in low numbers in grassy utility rights-of-way or road corridors.

CUMULATIVE EFFECTS

The incremental effects of other federal, non-federal, or private actions would not change, regardless of alternative. Any difference in cumulative effects would be reflected in the variation of an alternative's direct and indirect effects.

The state and national parks within the proclamation boundary will trend toward older forest, including areas greater than 150 years of age, with limited young age forest areas, and limited habitat for young age forest MIS (yellow-breasted chat and eastern towhee). The grassland MIS, field sparrow, is unlikely to be provided for in these areas, but may persist in utility rights-of-way or along road corridors. MIS associated with Southern yellow pine (prairie warbler and pine warbler) would not likely be provided for in these areas. Northern bobwhite quail may persist in utility rights-of-way or along road corridors, but active habitat management for the species is unlikely. Pitch pine would exist only where it survived the southern pine beetle epidemic. Woodland and wooded grassland/shrubland MIS (northern cardinal, summer tanager, and chipping sparrow) would not be provide for in these

areas. State and national parks would provide habitat for riparian MIS (Acadian flycatcher) and older forest MIS (cerulean warbler, black-throated green warbler, ovenbird), however. The relative mix of forest communities would remain the same over five decades. The state of Kentucky's Beech Creek Wildlife Management Area will provide a variety of forest age classes but is unlikely to have forest over 150 years old. MIS should be provided for in this area except for yellow pine and woodland and wooded grassland/shrubland species. Riparian MIS may or may not be provided for on site-specific projects. The relative mix of forest communities would remain the same over the next five decades.

Private actions on non-forest lands frequently include the maintenance of grassy openings in the form of fields, pastures, and lawns. Whether it is suitable habitat for a given species depends on factors such as the size of the area, its condition and composition, its location relative to houses and other buildings, and the habitat context in which it occurs (see Fragmentation section). This is best determined during site-specific project analysis. Private land may provide a range of forest communities, including a range of age classes from recently cut forest to stands greater than 150 years of age. However, events on private land are somewhat unpredictable and the relative amount of young versus old stands and relative balance of forest communities is always in question from year to year. Likewise, available habitat for MIS is unpredictable. However, analysis of satellite data suggests a slight increasing trend in forested land around the DBNF, with a corresponding slight decrease in open or grassy land. Recent Forest Inventory and Analysis data suggest that about 6.5 percent of all land (about 133,000 acres) in all ownerships within the proclamation boundary is in seedling/sapling (early aged forest) condition. Part of this is pasture and cropland reverting to forest, and part is land on which timber harvest has occurred.

OTHER EFFECTS

Other effects remain the same among alternatives. That one particular piece of land exists in one habitat form used by one organism and not in another habitat form used by a different organism implies that not every piece of ground at any one time is beneficial to any organism or group of organisms. This is seen in practice: an ovenbird generally is not found in a 0-10 year old shelterwood harvest area, and a yellow-breasted chat generally is not found in 70-80 year old forest. Areas may be maintained in a particular habitat condition for either short or long periods, during which they are not available as habitat for a species requiring different conditions.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A in the 1985 Plan would schedule about 6,000 acres of forest regeneration per year (about 60,000 acres per decade). This was adjusted with revised volume tables to about 5,000 acres per year (about 50,000 acres per decade). Of this, approximately 3,000 acres per year would be harvested in hardwood or northern conifer forest types. The remaining amount, about 2,000 acres per year, reflects regeneration of yellow pine forest types. The yellow pine regeneration would be expected in areas affected by the southern pine beetle epidemic and may not result in timber harvest. As compared to current conditions, this would increase the acreage of young-age forest stages but decrease acres of older forest, particularly in the 61-130 year old range (Figure 3 - 23, Figure 3 - 24, and Figure 3 - 25. The number of acres of forest producing hard mast would likely decrease.

The application of prescribed fire in this alternative should help maintain herbaceous and woody diversity on the forest and promote the retention of oak dominated uplands and re-establishment of yellow pine dominated uplands. With the exception of southern yellow pine dominated forest, no appreciable change in relative amounts of forest communities would be expected. About 35,000 acres of southern yellow pine would be replanted over the next two decades in areas decimated by the southern pine beetle. About 46,800 acres of southern yellow pine would be replanted over the next five decades in areas decimated by the southern pine beetle. About 2,371 acres of grassy openings would be maintained by the end of the second decade for species requiring grassland habitat. About 2,800 acres of grassy openings would be maintained by the end of the fifth decade for species requiring grassland habitat. This alternative would not contain a specific riparian prescription area, (no change from current condition) and the condition of riparian habitat in the alternative would be determined by site-specific analysis.

This alternative would provide for early-age forest for three management indicator species, white-tailed deer, eastern bluebird, and rufous-sided towhee (now called eastern towhee). White-tailed deer, in this alternative, is tied specifically to regeneration conditions (0-10 year-old forest). In the first decade, around 50,000 acres of 0-10 year-old forest would be provided for this species. While this would be about an 11 percent decrease from current levels, this condition should remain stable through at least the 5th decade. Based on recent analysis (USDA Forest Service 2000), this change in habitat conditions may not necessarily change population numbers. Eastern bluebird in this alternative is specifically tied to snag/cavity development in the context of grassy openings or 0-10 year forest. In the first decade, about 2,300 acres of grassy openings would be provided, an increase of about 4 percent. By the 5th decade, about 2,800 acres of grassy openings would be provided, an increase of about 37 percent. The 0-10 year-old forest discussed in regard to white-tailed deer would also be provided. Continuing the Standard from the 1985 Plan of leaving three snags per acre would provide potential cavities for nesting. Based on recent analysis (USDA Forest Service 2000), such changes in habitat condition may not alter populations of eastern bluebird. Eastern towhee in this alternative is specifically associated with 0-10 year old forest, brushy fields, and small open areas. This habitat is similar to that provided for the eastern bluebird but without the snag/cavity dependence. Based on recent analysis (USDA Forest Service 2000), there is some potential for such habitat change to reduce eastern towhee populations on the DBNF.

Older age forest management indicator species in this alternative include pileated woodpecker, eastern gray squirrel, and red-cockaded woodpecker. Pileated woodpecker is specifically tied to old-growth timber in this alternative. Old-growth timber is defined as decadent trees of at least 20 inches dbh, in stands with two distinct canopy layers and a crown closure of about 70 percent. Snags at least 22 inches dbh are also required. These conditions are generally provided in oak forest over 130 years old and mixed mesophytic forest over 100 years old. In the first decade of the 2004 Forest Plan, about 78,200 acres in this condition would be provided, an increase of about 100 percent. After five decades, about 186,800 would be available, an increase of about 380 percent. This change in habitat would be expected to lead to an increase in population numbers of pileated woodpecker. Eastern gray squirrel, a game species, is specifically tied to older aged forest capable of producing mast and providing den trees, cavities, and other appropriate nesting sites. The 1985 Plan roughly defined this as oak dominated forest of more than 50 years of age. In the first decade of the 2004 Forest Plan, about 200,900 acres of forest meeting these criteria would be available for habitat, a decrease of about five percent. After five decades, about 208,400 acres of this habitat would available, about two percent less than current conditions. This change in habitat would not be expected to alter the

DBNF's gray squirrel population. The red-cockaded woodpecker, a federally listed endangered species, is specifically tied to older yellow pine trees, in particular, shortleaf pine. At present, this habitat no longer exists on the DBNF, and the species is considered extirpated from Kentucky. After the first decade of the 2004 Forest Plan, about 20,800 acres of yellow pine, primarily shortleaf pine, would be present in the 0-10 year old condition, about 16 times the current amount. After five decades, about 46,800 acres would be available, an increase of about 38-fold. However, none of this would be suitable habitat until the 7th or 8th decade of the 2004 Forest Plan. Red-cockaded woodpecker habitat may be provided in the long-term but not the short-term.

An analysis of population and habitat trends for the above MIS from 1985 to 2000 (USDA Forest Service 2000) concluded that only eastern towhee and eastern gray squirrel served well as ecological indicators. Therefore, a new MIS list with eastern towhee as an ecological indicator and white-tailed deer as a game species, but not an ecological indicator, was used to develop alternatives for the 2004 Forest Plan. Eastern gray squirrel was not included as an MIS for lack of an effective means to monitor the species. To enable the comparison of the draft alternatives with Alternative A, the MIS developed for the alternatives were considered under the direction contained in Alternative A.

Restoration of pitch pine, an MIS species, is not likely under this alternative, and the species may not be represented after five decades except for scattered individuals established through natural regeneration. Acadian flycatcher, a riparian MIS species, would have the same relative amount of riparian habitat as currently found, but there would be increased amounts of open and structurally diverse habitat compared to present conditions. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. What populations could be compared to current conditions remains unknown because their response to the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS dependent on older southern yellow pine (70-80+ years), would not be provided for in the first five decades. In the long-term, 7 to 8 decades from implementation, this alternative would provide for the pine warbler. In any case, this species may persist in low numbers between remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, along with chipping sparrow and northern cardinal, MIS associated with woodland and wooded grassland/shrubland, would not be specifically provided for under this alternative. This alternative, which represents continuation of the 1985 Plan, also would not provide the woodland or wooded grassland habitat components for the MIS northern bobwhite quail. Incidental habitat for these species might be scattered across the forest, however. Black-throated green warbler, Cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative, with about a two percent increase in habitat acreage after one decade. A decrease in this habitat of about eight percent would result after five decades. This reduced habitat could be expected to result in slightly fewer numbers of at least some species associated with this habitat condition. Acres of forest capable of producing mast would decrease about five percent in the first decade and by the 5th decade the reduction would be only two percent. The change in this habitat condition is likely to result in only small changes in populations of species dependent on mast. About 15,000 acres of thinning of forest stands would occur in each decade, which should result in a forest with more varied and complex vertical and horizontal structure. Nearly the entire amount represents an increase over current conditions. Cerulean warbler and other species may benefit from this structural change. Habitat for the MIS prairie warbler would be provided at a level above the existing condition, about 16 times current after one decade, and about 38 times current after five decades. Grassland habitat for the MIS field sparrow would increase about four percent in this alternative after one decade and about 37 percent higher after five decades.

Young age forest habitat for the MIS eastern towhee and yellow-breasted chat would decrease about 11 percent under this alternative through the 5th decade. The MIS white-tailed deer was selected as a game species MIS. As such, it is not specifically tied to any particular habitat condition. But it should benefit from the variety of habitat conditions that would be provided under this alternative.

CUMULATIVE EFFECTS

For Alternative A, older stands on state and national park areas would help balance the variety of forest ages and conditions within the proclamation boundary. Young age forest on the state wildlife management area and private lands would increase the relative amount of this habitat within the proclamation boundary. Wildlife openings on the state wildlife management area would increase the relative amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary.

OTHER EFFECTS

No other effects from implementing this alternative are expected beyond those indicated for all alternatives above.

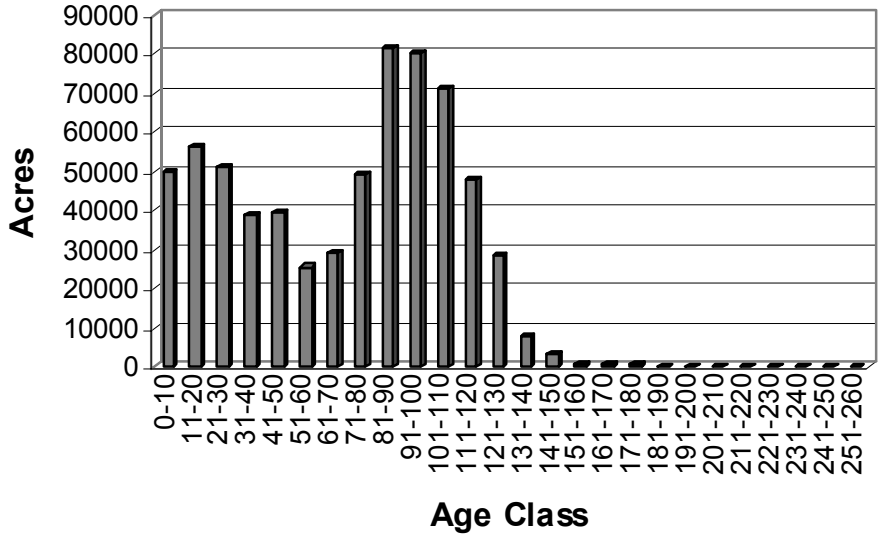

Figure 3 - 23. Alternative A, 1st decade 10-year Age Class distribution

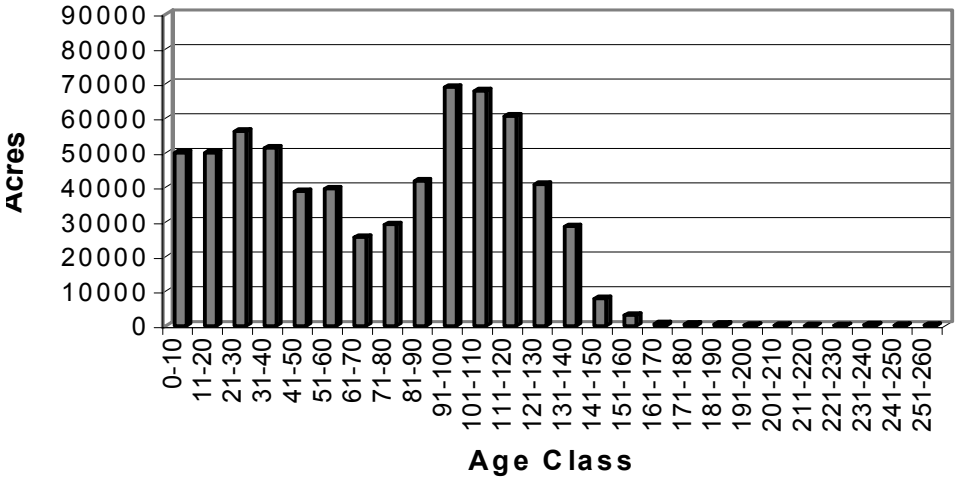

Figure 3 - 24. Alternative A, 2nd decade 10-year age class distribution.

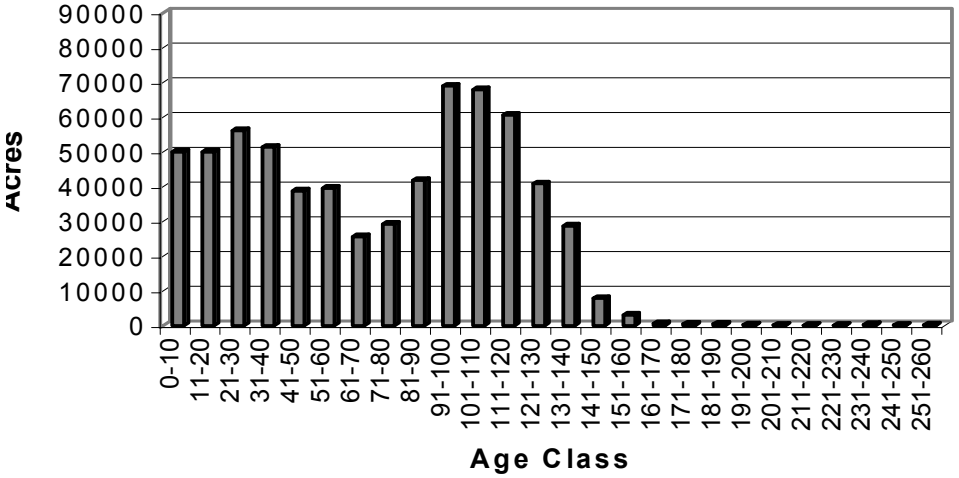

Figure 3 - 25. Alternative A, 5th decade 10-year age class distribution.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1 would schedule about 700 acres of forest regeneration each year. This would involve harvesting 260 acres per year from hardwood or northern conifer forest types. The rest would come from yellow pine restoration efforts, which might not include timber harvest. Compared to existing condition on the ground, this alternative would decrease the total number of acres in young age forest about 88 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would decrease these acres by about 62 percent in the first decade. This reduction of habitat is expected to decrease populations of species that depend on it. In the first decade, the amount of forest in the 60-130 year-old range Figure 3 - 26, Figure 3 - 27, and Figure 3 - 28) would increase about three percent, and by the fifth decade it would decrease about 26 percent. Compared to current levels, some population decrease among species associated with this habitat condition could occur by the fifth decade. Acres of forest capable of producing hard mast would be decreased about four percent over the next decade, but increased about 39 percent by the end of the fifth decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. In the short-term, little change would be expected in populations of mast dependent species. There is potential for great increase by the fifth decade, however.

Some changes in the relative amounts of forest communities would be expected. As the forest ages in this alternative, the likelihood of natural succession replacing the oak component would increase. Shade tolerant tree species would be expected to increase in the midstory and overstory, eventually replacing some oak stands. Over time, this effect could counteract smaller increases in acres with mast production potential, growing up from younger age classes. Prescribed fire would be utilized in this alternative, primarily to help restore and maintain a yellow pine community on the DBNF. Application of prescribed fire would increase herbaceous diversity in many areas and help maintain the open conditions of woodlands and wooded grasslands/shrublands. About 8,700 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted over the next two decades in areas decimated by the southern pine beetle. About 21,800 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted over the five decades in areas decimated by the southern pine beetle. The increase in 0-10 year old yellow pine, about 260 percent in each of the next five decades, is expected to promote populations of species that utilize this habitat. Another 750 acres of wooded grassland/shrubland would be created and held through the second decade. These acres are shown in the 0-10 year old age class in the figures and tables in this section. In addition, 2,870 acres of hardwood woodland would be created and held into the second decade. If sufficient pine were available, up to 500 acres of yellow pine woodland would be established by the end of the second decade. These acres are included in forest acres in the figures and tables in this section. Any acres in woodland and wooded grassland/shrubland would represent increases over the current condition. This change in habitat conditions is expected to increase the population numbers of some associated species or at least improve individual health. About 900 acres of grassy openings would be maintained in each of the first five decades for species requiring grassland habitat. This represents a decrease of 59 percent over current conditions. This change in habitat conditions is likely to decrease some populations of dependent species. Continuous Inventory of Stand Condition only indicates about 4,004 acres of riparian forest on the ground. However, about

100,000 acres of 100-year flood plain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine is specifically addressed in this alternative and would be represented on the ground after one decade and through the fifth decade. In addition to using the existing riparian habitat, Acadian flycatcher, a riparian species, could take advantage of areas managed for riparian-associated species. Populations of this species could be expected to increase. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. Because their response to habitat damage by the southern pine beetle epidemic is not fully understood, just how future prairie warbler populations would compare to current conditions is unknown. Pine warbler, an MIS dependent on older SYP (70-80+ years), would not be provided for in the first five decades, but this alternative would provide for the species long-term, 7 to 8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland as well as the chipping sparrow and the northern cardinal, MIS associated with wooded grassland/shrubland, would be provided for at minimum levels, but still at levels above the current condition. Populations of these species could be expected to increase slightly above current levels. The yellow pine woodland and wooded grassland habitat components utilized by the MIS, northern bobwhite quail, would be provided in this alternative, but not until the fifth decade. However, the species might be present in scattered patches of warm-season grass habitat. Any woodland and wooded grassland/shrubland would represent an increase from current conditions. As these habitat conditions increased under this alternative, small population increases of associated species could also be expected. Black-throated green warbler, cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative. Their habitat would increase about 13 percent during the first decade and about 42 percent through the end of the fifth decade. These increases are expected to increase populations of MIS associated with this habitat condition. About 1,825 acres of thinning of forest stands would occur in each decade, which would result in a forest with more varied and complex vertical and horizontal structure. Most of this would represent an increase over current conditions. Cerulean warbler and other species may benefit from this structural change. Field sparrow, an MIS associated with grassland, would be provided for only at minimum levels under this alternative. Grassland habitat for these species would be reduced about 59 percent over the current acreage, and populations of associated species would be expected to decrease. Eastern towhee and yellow-breasted chat, MIS associated with young-age forest, would be provided for under this alternative, but at minimum levels. Habitat for these species would be reduced about 62 percent, and a corresponding decrease in these MIS populations would be expected. The white-tailed deer was selected as a game species MIS. While not specifically tied to any particular habitat condition, as a species it benefits from a variety of habitat conditions. Because this alternative would foster habitat less diverse than in current conditions, slightly reduced deer populations could result. The various habitat conditions provided in this alternative should, however, provide useable habitat for the species.

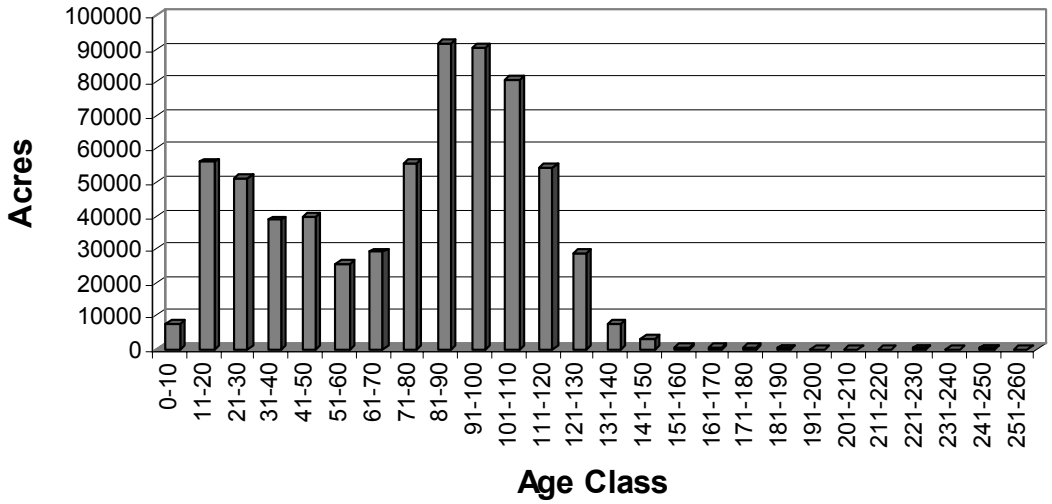

Figure 3 - 26. Alternative B-1, 1st decade 10-year Age Class distribution

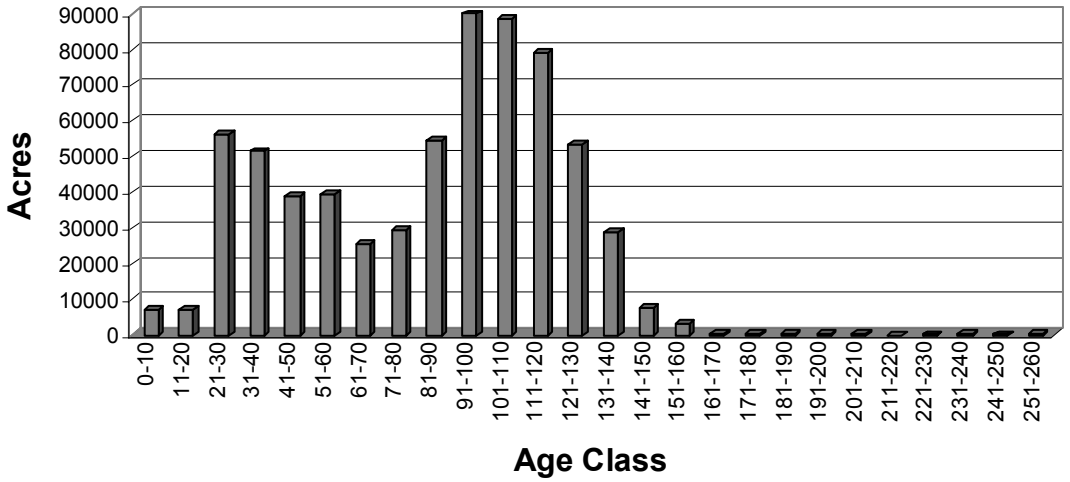

Figure 3 - 27. Alternative B-1, 2nd decade 10-year Age Class distribution.

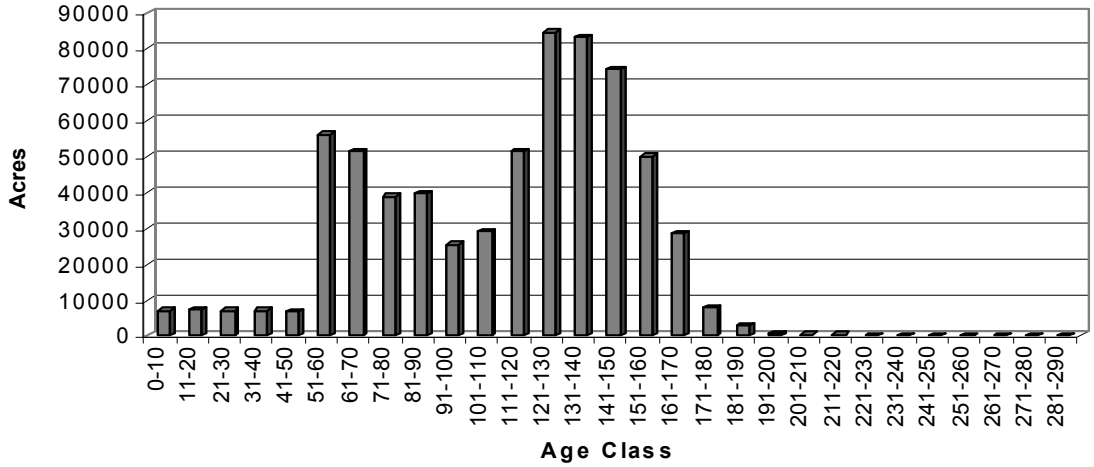

Figure 3 - 28. Alternative B-1, 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

Under Alternative B-1, older timber stands on state and national park land would contribute to a generally older forest condition within the proclamation boundary. Timber harvest on private land or the state wildlife management area may create young age forest conditions supplementing the amount provided by this alternative for young age forest MIS. Wildlife openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat across the proclamation boundary would be largely the result of management action on National Forest System land.

ALTERNATIVES C, C-1 AND D

DIRECT AND INDIRECT EFFECTS

Alternatives C, C-1, and D would schedule about 2,300 acres of forest regeneration per year. Of this about 1,480 acres per year during the first two decades would be associated with the harvest of hardwood and northern conifer forest types. The remainder would be part of the general yellow pine forest restoration and might not include timber harvest. Compared to current conditions, this alternative would decrease the total number of acres in young age forest about 60 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would increase these acres by about 21 percent in the first decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. This habitat change is expected to decrease populations of associated species. In the first decade, the amount of forest in the 61-130 year old range would increase by less than one percent and then decrease about 32 percent by the end of the fifth decade. In the first decade, no population changes in species associated with this habitat would be expected. In the fifth decade, however, reductions in populations of some species associated with this habitat condition would be expected (Figure 3 - 29, Figure 3 - 30, and Figure 3 - 31). Acres of forest capable of producing hard mast would be reduced over current levels by less than one percent in the first decade. By the end of the fifth decade, an increase of about 20 percent could be expected. Populations of species dependent on hard mast production would be likely to increase by the end of the fifth decade.

Changes in relative amounts of forest communities would be expected. The oak-dominated forest component should persist. Silvicultural activities including tree cutting and prescribed fire would help maintain oak on the DBNF. The use of prescribed fire should also contribute to the restoration and maintenance of a diverse herbaceous flora as well as woodlands and wooded grasslands/shrublands. About 8,400 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted over the next two decades in areas decimated by the southern pine beetle. About 40,200 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted over the next five decades in areas decimated by the southern pine beetle. The increase of 0-10 year old yellow pine over current conditions, an increase of 260 percent over current in each of next five decades, can be expected to support increased populations of associated species.

About 1,440 acres total of wooded grassland/shrubland would be created over the next two decades. Over five decades, this amount would expand to about 11,530 acres. These acres are shown in the 0-10 year old age class in Figure 3 - 29, Figure 3 - 30, and Figure 3 - 31. In addition, about 25,400 acres of woodland (about 25,300 acres hardwood) would be created through the first two decades. Over five decades, about 40,100 acres of woodland would be created. These are included in "forest acres" in Table 3 - 34. Any acres in woodland and wooded grassland/shrubland would represent increases from current conditions. These habitat changes can be expected to support increased populations of some associated species. About 2,200 acres of grassy openings would be maintained each of the first five decades for species requiring grassland habitat This represents an increase of less than one percent over current conditions. This change is not likely to result in any decrease in populations of species dependent on grassland conditions. CISC only indicates about 4,004 acres of riparian forest on the ground. However, about 100,000 acres of 100-year floodplain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine, an MIS specifically addressed in these alternatives, would be represented on the ground after one decade and through the fifth decade. Acadian flycatcher, a riparian MIS, would be able to use existing riparian habitat and expand into areas managed for riparian-associated species increasing its population on the DBNF. Prairie warbler, an MIS associated with young yellow pine stands, would be provided for under these alternatives. How its population would compare to current numbers is unknown because its response to habitat decimated by the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS that depends on older southern yellow pine (70-80+ years), would not be provided for in the first five decades, but these alternatives would provide for this species long-term, 7 to 8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, as well as chipping sparrow and northern cardinal, MIS associated with wooded grassland/shrubland would be provided for under these alternatives.

The yellow pine woodland and wooded grassland habitat component utilized by the MIS northern bobwhite quail would be provided under these alternatives, but not until the fifth decade. However, the species would likely be present in scattered patches of warm season grass habitat. Any amount of woodland and wooded grassland/shrubland created would represent an increase over current conditions. Black-throated green warbler, Cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for under these alternatives. About 9,000 acres of thinning of forest stands would occur in each decade, resulting in a forest with more varied and complex vertical and horizontal structure. This would all be an increase beyond existing conditions. Cerulean warbler and other species could benefit from this structural change. The grassland habitat for the MIS field sparrow provided under these alternatives would represent a decrease of about 12 percent from current conditions. Habitat provided for the MIS eastern towhee and yellow-breasted chat by these alternatives would represents an increase of 20 percent over current conditions. The MIS white-tailed deer was selected as a game species MIS. While it is not specifically tied to any particular habitat condition, this species benefits from a variety of habitat conditions. The varied habitat conditions provided under these alternative should include useable habitat for the species.

Figure 3 - 29. Alternatives C, C-1, D; 1st decade 10-year Age Class distribution

Figure 3 - 30. Alternatives C, C-1, D; 2nd decade 10-year Age Class distribution.

Figure 3 - 31. Alternatives C, C-1, D; 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

Timber harvest on private lands or the state wildlife management area could create young age forest conditions supplementing the amount provided under these alternatives for young age forest management indicator species. Grassy openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat within the proclamation boundary would be largely the result of management action on National Forest System land.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Alternative E-1 would schedule about 3,600 acres of timber harvest per year (36,000 acres per decade). Of this amount, 3,200 acres per year would come from the timber harvest of hardwood and northern conifer forest types. Compared to existing conditions on the ground, this alternative would decrease the total number of acres in young age forest about 35 percent in the first decade. Compared to the actual 0-10 age class created from management action in the last 10 years (ca. 18,400 acres), this alternative would increase these acres by about 98 percent in the first decade. As a result of both management action and changes following the southern pine beetle epidemic, the actual amount of 0-10 age class currently on the Forest is close to the amount prescribed under Alternative A. This change in habitat from current conditions is expected to result in increases of populations of species associated with this habitat. In the first decade the amount of forest in the older forest, particularly in the 61-130 year old range increases about four percent in the first decade and decreases about 37 percent by the end of the fifth decade. In the first decade, no change to populations of species associated with this habitat is expected. In the fifth decade, reductions in the populations of some species associated with this habitat condition would be expected (Figure 3 - 32, Figure 3 - 33, and Figure 3 - 34). Acres of forest capable of producing hard mast will be reduced over current levels about three percent in the first decade. By the end of the fifth decade, an increase of about six percent is expected. Species dependent on hard mast production may have slight increases in population numbers by the end of the fifth decade.

Changes in relative amounts of forest communities would be expected. The oak-dominated forest component should persist on the landscape. Silvicultural activities including tree cutting and some prescribed fire would help maintain the oak on the DBNF. The use of prescribed fire will also contribute to the restoration and maintenance of a diverse herbaceous flora on the DBNF, and woodlands and wooded grasslands/shrublands. About 8,700 acres of southern yellow pine, of which about 1,000 acres would be pitch pine, would be replanted in southern pine beetle decimated areas over the next two decades. About 21,800 acres of southern yellow pine, of which about 3,000 acres would be pitch pine, would be replanted in southern pine beetle decimated areas over the next two decades. Another 750 acres total of wooded grassland/shrubland would be created and held through the first five decades. This acreage is shown in the 0-10 age class in charts. In addition, about 3,700 acres total of woodland would be created and held through the two decades (about 2,000 acres of hardwood woodland). Through the fifth decade, this would increase to about 4,300 acres. These acres are included in “forest acres” in charts. All acres in woodland and wooded

grassland/shrubland are increases from current condition. The change in these habitat conditions is expected to increase population numbers of some species associated with them. About 900 acres of grassy openings would be maintained in each of the first five decades for species requiring grassland habitat. This represents a decrease of about 59 percent over current conditions. This change is likely to result in the decrease of some populations of species dependent on these conditions. CISC only indicates about 4,004 acres of riparian forest on the ground. However, about 100,000 acres of 100-year flood plain occur on the ground. The Riparian Corridor Prescription area in this alternative provides an effective increase of 38,800 acres (about a 39% increase) in management for riparian values over the current condition (Table 3 - 34). This increase in management emphasis is expected to result in increases in populations of species associated with riparian habitat.

Restoration of pitch pine is specifically addressed in this alternative and would be represented on the ground after one decade and through the fifth decade. Acadian flycatcher, a riparian species, would have adequate habitat in this alternative. Prairie warbler, an MIS associated with young yellow pine stands would be provided for in this alternative. It is not known what populations will be like compared to current condition, as their response to the southern pine beetle epidemic is not fully understood. Pine warbler, an MIS dependent on older SYP (70-80+ years), would not be provided for in the first five decades, but the alternative provides for the species long-term, in 7-8 decades from implementation. This species may persist in low numbers in remaining pockets of older yellow pine. Summer tanager, an MIS associated with woodland, and chipping sparrow and northern cardinal, MIS associated with wooded grassland/shrubland, would be provided for at minimum levels, but still at levels above the current condition. The yellow pine woodland and wooded grassland habitat components utilized by the MIS northern bobwhite quail would be provided in this alternative, but not until the fifth decade. However, the species would likely be present in scattered patches of warm season grass habitat on the DBNF. All woodland and wooded grassland/shrubland represents an increase from current condition. Black-throated green warbler, cerulean warbler and ovenbird, MIS associated with older forest (70+ years), would be provided for in this alternative. In the first decade, it increases about five percent and is about two percent higher than current conditions in the fifth decade. No increase in populations of species associated with this habitat condition is expected. About 22,500 acres of thinning of forest stands would occur in each decade, which will result in a forest with more varied and complex vertical and horizontal structure. All thinning acres represent an increase from current conditions. Cerulean warbler and other species may benefit from this structural change. Grassland habitat for the MIS field sparrow would be provided at a level reduced about 59 percent from current conditions. Eastern towhee and yellow-breasted chat would be provided for in this alternative. Habitat for these species would be reduced about 35 percent over current acreage. The MIS white-tailed deer was selected as a game species MIS. As such it is not specifically tied to any particular habitat condition. As a species, it benefits from a variety of habitat conditions on the landscape. The various habitat conditions provided in this alternative should provide useable habitat for the species.

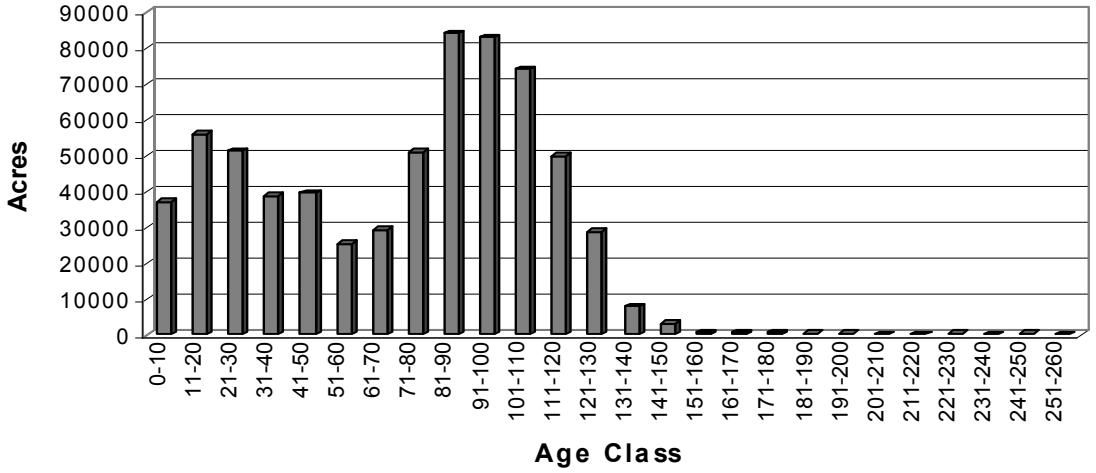

Figure 3 - 32. Alternative E-1, 1st decade 10-year Age Class distribution

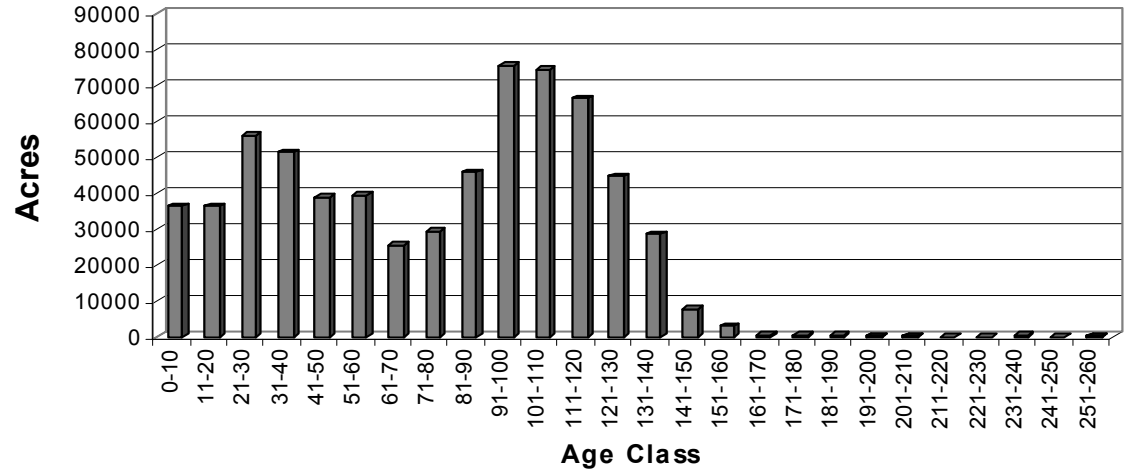

Figure 3 - 33. Alternative E-1, 2nd decade 10-year Age Class distribution.

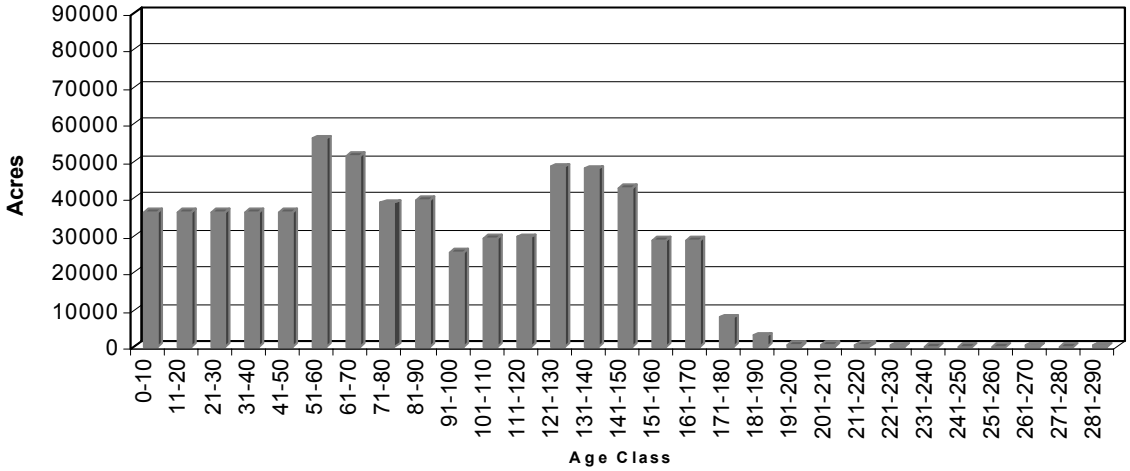

Figure 3 - 34. Alternative E-1, 5th decade 10-year Age Class distribution.

CUMULATIVE EFFECTS

For Alternative E-1, older stands on state and national park lands would help to balance a variety of forest ages and conditions within the proclamation boundary. Timber harvest on private land or the state wildlife management area may create young age forest conditions supplementing the amount provided by this alternative for young age forest MIS. Wildlife openings on the state wildlife management area would increase the amount of grassland maintained as habitat for grassland dependent species within the proclamation boundary. Reasonably anticipated changes in relative abundance of habitat across the proclamation boundary will be largely the result of management action on National Forest System land.

OTHER EFFECTS

No other effects from implementation of Alternatives B-1, C, C-1, D or E-1, beyond those already indicated for all alternatives, would be expected.

FOREST HEALTH

Affected Environment

There are many views of what constitutes a healthy forest. For the purposes of this analysis, forest health is defined as: "the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance – note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time" (Helms 1989).

Below are listed a variety of items considered when determining the relative health of a forest:

- Dead standing trees
- Broken limbs in trees
- Holes in trees
- Dying trees
- Woody debris on the forest floor
- Dense numbers of trees
- Sparse numbers of trees
- Large old trees
- Small young trees
- Gaps in the forest canopy
- Grassy openings
- Ability to ward-off insect infestation or disease
- Presence of particular species
- Absence of particular species
- Fire scars on trees
- Presence of invasive species

To some observers, dead, dying, and down trees are evidence of poor forest health while others view them as evidence of cyclical diversity. Each characteristic listed above, and others, can be viewed as indicating either good or bad forest health, depending on an observer's frame of reference and on the scale from which they are making their observation. Differing perspectives of a healthy forest can be correct, depending on such factors as scale, location, and management goals.

Diversity is one way to account for all of the characteristics mentioned above. Biological diversity, often abbreviated as biodiversity "refers to the diversity of life in all its forms and all its level of organization, not just the diversity of plant, animal, and microorganism species" (Hunter 1990, p. 7). Richness (number of forest types) and evenness (distribution of abundance among different forest types) provide some indication of diversity. For the purpose of this analysis, the number of forest types present on the Forest will be a measure of richness, and the abundance of each forest type will be a measure of evenness. By managing for diversity, we manage for all life forms endemic to the area. Stability (sustain over time) is another reason to promote diversity. Diverse ecosystems tend to be more stable than those less diverse (Hunter 1990, p. 7-14).

For the purposes of this analysis, a healthy forest ecosystem would have the following characteristics (Kolb 1994, p.10-15):

- The physical environment, biotic resources, and trophic networks to support productive (based on management goals and objectives) forests during at least some seral stages
- Resistance to catastrophic change and/or the ability to recover from catastrophic change at the landscape level
- A functional equilibrium between supply and demand of essential resources (water, nutrients, light, growing space) for major portions of the vegetation
- A diversity of seral stages and stand structures that provide habitat for many native species and all essential ecosystem processes.

The health of a forest ecosystem is more appropriately assessed at a landscape scale (rather than at a tree or stand scale) and cannot be evaluated in a social vacuum. It depends both on society's objectives for the forest and on the interaction of biotic (including human) and abiotic processes that produce the range of habitats required for continued existence of native species. To appreciate the concept of a healthy forest, two basic facts should be kept in mind. First, forests are composed of many different smaller dynamic units, which have different baseline rates of growth and mortality; these units are dynamic, varying over time depending on changing local biological interactions and physical conditions. Second, native and non-native insect populations and diseases also are dynamic as well as opportunistic; they increase and decrease in response to changing forest conditions.

A summary of forest health indicators used in this analysis appears in Table 3 - 35. These species and conditions are used to compare the alternatives as described in Chapter 2. A discussion of each indicator appears after the table. Many more invasive species are present or potentially could occur on the DBNF. The intent here is to assess forest health using small selection of invasive species.

The Forest Service monitors forest health nationally[5], and in the southeast, forest health is monitored by tracking:

- Trends in watersheds having improved watershed conditions
- The status and/or trends in populations, habitats, and ecological conditions for the red-cockaded woodpecker (associated with shortleaf pine), golden-winged warbler (associated with young-age deciduous forest, mostly at higher elevations), and cerulean warbler (associated with mature deciduous forest)
- Trends in acres at extreme risk from fire, insects, diseases, and invasive species.

[5] United States Department of Agriculture-Strategic Plan, USDA-FS, 2000, p. 16-19.

Table 3 - 35. Indicators Used to Assess the Effects to Forest Health.

Indicator	2002 Status
Richness (measured by number)	
Major forest types	6
Evenness (measured by thousand-acres)	
Xeric oak	40
Mesic oak	267
Pine & pine-hardwood	88
Hardwood-pine	68
Mixed mesophytic	165
Cove conifer	34
Early succession provided	N/A
Non-native Invasive Species	
Gypsy moth[1] (measured by thousand-acres)	
Extreme risk condition	75
High risk condition	82
Moderate risk condition	111
(measured by presence)	
Hemlock woolly adelgid	Nearby
Kudzu (Forest-wide)	Present
Asiatic bittersweet (Morehead & Stanton)	Present
Japanese knotweed (Stearns)	Present
Nepal browntop (Forest-wide)	Present
Musk thistle (Morehead)	Present
Spotted knapweed (London)	Present
Crown vetch (Morehead and London)	Present
Zebra mussel	Nearby
Asian clam	Present
Beech bark disease (measured by presence)	Nearby
Native Insects and Pathogens	
(measured by thousand-acres)	
Southern pine beetle (impacted)[2]	100
Oak Decline & Red-oak borer[3]	
Damaged stands	96
Vulnerable stands	61
Unaffected stands	515
Physical Tree Features	
Fire scars and butt-rot (measured by presence)	Present
Live Crown Ratio[4] (measured by percent)	Unknown
Overstory Vegetation	
Older age trees[5] (measured by thousand-acres)	308
Tree density[6] (measured by tree density)	Unknown

[1]Gypsy Moth risk rating is based on an analysis of data from the Forest's corporate database, CISC (Continuous Inventory of Stand Condition). The attribute data (forest type, condition class, site index, and age) from CISC was summarized using the CISC Risk Rating For Gypsy Moth model, which was derived from the work of Kurt W. Gottschalk, Research Scientist, and others, USDA Forest Service, Northeastern Research Station, Morgantown, WV Field Office.

[2]High-risk southern pine beetle – Yellow pine forest types, 50 years or older with basal area greater than or equal to 120 square-feet per acre.

[3]Oak Decline risk rating is based on an analysis of data from the Forest's corporate database, CISC (Continuous Inventory of Stand Condition). The attribute data (forest type, condition class, site index, and age) from CISC was summarized using the Oak Decline Risk Rating model, which was derived from the work of Steve Oak, Forest Pathologist, USDA Forest Service, Forest Health Protection, Asheville, NC Field Office.

[4]Live Crown Ratio not available at the landscape scale of a Forest Plan. More appropriately used at the individual tree or stand level.

[5]Older age trees – Trees greater than 80 years old (for this analysis). This is generally the age in the growth cycle of DBNF stands at which the overstory is beginning to slow in periodic annual increment for height, diameter, basal area, or volume. For some tree species this age is considerably less (e.g. Virginia pine, Scarlet oak).

[6]Tree density, also referred to as stocking (overstocked, understocked, adequately stocked) is not available at the landscape scale of a Forest Plan. It is more appropriately used at the stand level.

Analysis Area

For the purpose of assessing how the 2004 Forest Plan would affect forest health, only National Forest System land areas within the proclamation boundary of the DBNF are considered for each alternative. However, due to the distribution patterns of land ownership and regional nature of some non-native pest problems (including gypsy moth and hemlock woolly adelgid) the analysis area is expanded for those pests, as appropriate.

Richness and Evenness

Eastern Kentucky, which includes the DBNF, lies within the Southern Appalachian Hardwood Region, the world's largest contiguous temperate hardwood forest. "Its upland mixed-hardwood stands are diverse ecosystems that have developed in response to a broad array of biotic, abiotic, and anthropogenic forces" (Barrett 1995, p. 173). However, most of the DBNF lies west and north of the richest portions of this forest. Braun (1950) described areas within portions of what is now the Redbird District as rich in woody plants and having a diverse understory, but it still does not compare to places such as the Great Smoky Mountains. The physiographic provinces of the Appalachian Plateau were discussed earlier in this chapter under Description of Ecological Units.

The forests of today are a result of past use and widespread ecological events. Native Americans, prior to arrival of European settlers, often maintained open forests by partial clearing and through the use of fire. Native Americans and pioneers used the forests for food, grazing, fuelwood, shelter, and cleared the forest for crops and fields. Many of the steep slopes cleared for pasture and agriculture were later abandoned, allowing forest cover to return. From 1870 to 1920, extensive logging occurred in response to the demand for the variety of hardwood products then available from the forests (Barrett 1995, p.182).

At times, wildfire was destructive to Appalachian hardwoods. Fire killed young stands and damaged the trunks of larger hardwood trees contributing to decay and lowering timber product quality. Aggressive fire prevention and suppression efforts began in the mid-1930s, minimizing damage to forest products but changing the structure of stands. For example, exclusion of fire contributed to a noticeable decrease in the oak regeneration that would normally follow natural disturbance or timber harvest (Barrett 1995, p.183). During the nineteenth century, widespread tree cutting for settlements, agriculture, and iron ore production took place with little, if any, concern for environmental quality.

Forest diseases, including chestnut blight and Dutch elm disease, also influenced species composition, structure, and spatial distribution. Within 50 years of the 1906 discovery in New York of Cryphonectria parasitica, the causal organism of chestnut blight, the American chestnut was virtually eliminated from its entire natural range as a dominant forest tree. Prior to the blight, chestnut trees were one of the most common forest trees in the eastern United States. The American elm is no longer a major component of eastern hardwood forests as a result of the Dutch elm disease that entered the United States in the 1930s (Smith, W.H. 1970, p.204). "Even with these significant disturbances, the Southern Appalachian Hardwood Region, in which upwards of 130 tree species have been identified, is considered one of the two most important centers of biological diversity in the United States (Barrett 1950, p.184).

Today's forests are mostly "second or third-growth". Tree species common to the DBNF can be grouped into six major forest communities, which are described in Appendix B. The amount of each forest community is presented in this analysis (Table 3 - 35) to provide some indication of the evenness that existed as of 2002. Tree species composition and condition within these forest types

will vary from early successional to late successional, from early age to old age, and from densely stocked to sparsely stocked. These conditions are constantly changing as a result of tree growth, management activities and environmental events (i.e., wind, snow, insect and disease). The area (acres) of early seral trees expected as a result of management activities is intended to provide some indication of the richness that existed as of 2002. A summary of stand conditions was not included in this analysis because it is more appropriately considered at the landscape or stand scale.

Native and Non-native Invasive Species

Nationally, the USDA Forest Service Strategic Plan (2000 Revision) identifies a FY 2006 milestone for achieving a five percent decrease in acres at extreme risk from insects and disease. This analysis will assess the risks of gypsy moth and oak decline with the assumption that these estimates would be an indication of risk from other insects and diseases.

(Non-Native) Gypsy moth (European) is a non-native invasive insect intentionally brought to the United States from France to start a silk industry. It was accidentally released in eastern Massachusetts in the late 1860s. Despite many early attempts to halt its spread, by 1994 the gypsy moth had become established in all or parts of 16 states plus the District of Columbia. It continues to spread into uninfested areas (Gypsy Moth Management in the United States FEIS 1995, p.1-4) is a major defoliator of deciduous hardwood forests. It was first introduced from Europe into Massachusetts in 1869, and because the favored host, oak, is widespread in the eastern deciduous forests, it thrived and continues to expand its range west and south each year. By the 1980s, the gypsy moth was established throughout the Northeast (SAMAB 1996). The generally infested, or quarantine area, extends from New England, south into Virginia, west to Ohio, and includes all of Michigan. As the infested area of gypsy moth expands, the frequency of accidental introductions of gypsy moth on the Southern Appalachian Area national forests will increase. Increasing recreational use of national forest lands may increase the number of accidental introductions of gypsy moth on the Daniel Boone National Forest lands. Accidental introductions of gypsy moth may lead to the use of insecticides to eliminate (or eradicate) and prevent the gypsy moth from becoming established on the Forest Currently, the DBNF is outside of the gypsy moth quarantine area however, single male moth captures have been found on the Morehead and London Districts of the DBNF.

The gypsy moth completes a single generation each year. First instar larvae (caterpillars) emerge from egg masses in April or early May. As temperatures increase, the caterpillars leave the egg masses during daylight hours and climb into the forest canopy. Upon reaching the tips of branches, larvae may spin down on silken threads and disperse on the wind. Most larvae are dispersed within the local area, but some may be carried for distances greater than twelve miles (Taylor and Reling 1986). Larvae may repeat this dispersal process several times before settling down to feed. Male caterpillars usually pass through five larval instars (or, growth stages) and females pass through six. Larvae usually complete their development by early to mid-June and seek a sheltered location for pupation. The pupal stage lasts about two weeks at which time the adult emerges. The male adult moth is dark brown and bears several black bands across the front wings and are capable fliers. The female moth is nearly white, with black bands across the front wings. Females cannot fly but they can walk short distances from their site of pupation. Females release a potent sex attractant (pheromone) to allure male moths for mating. Once mated, the female deposits her brood in a single mass of eggs and dies. The egg mass may contain from 75 to 1,000 eggs. Within four to six weeks, embryos develop into larvae within the eggs, over winter and hatch the following spring.

The gypsy moth spreads over relatively short distances by the ballooning of first instar caterpillars on wind currents. The insect also may spread over much greater distances via human transport. Long distance spread occurs by two mechanisms, the transport of caterpillars or the transport of egg masses. People may pick up larvae in infested areas and carry them on their vehicles, belongings, or clothing to uninfested forested areas. The transport of the gypsy moth via egg masses occurs when vehicles, equipment, or household belongings infested with egg masses are brought into an uninfested areas in spring as the caterpillars are hatching.

Gypsy moth larvae feed on more than 500 species of trees, shrubs, and vines. Favored hosts include oak, apple, birch, basswood, witch hazel, and willow. Hosts moderately favored by gypsy moth include maple, hickory, beech, black cherry, elm, and sassafras. Least favored hosts include ash, yellow poplar, American sycamore, hemlock, pine, spruce, black gum, and black locust. Late instar larvae can feed upon tree species that younger larvae avoid, such as hemlock, maple, pine, and spruce. Feeding on less favored host plants usually occurs when high density larval populations defoliate the favored tree species and move to adjacent, less favored species of trees to finish their feeding and development. An individual gypsy moth caterpillar consumes the equivalent of approximately one square meter (10.75 square feet) of foliage during its development. A typical upland oak forest has 2.5 - 4.5 square meters of foliage per square meter of ground surface area. Thus, the feeding of a relatively few, healthy caterpillars can result in severe defoliation of oak in a stand.

Defoliation by the gypsy moth may reduce tree vigor, reduce growth of shoots and stem, cause dieback of the crown, trigger a failure of hard mast production, and sufficiently weaken a tree such that it is attacked and killed by wood-boring insects and root decay fungi. Hardwoods in a vigorous condition often can tolerate a year or two of defoliation before canopy dieback becomes pronounced. However, hardwoods that are stressed by drought, oak decline, or some other factor tolerate defoliation less well. The damage caused by gypsy moth feeding in spring is harmful because trees must draw upon reserve carbohydrates and nutrients to produce a second canopy of leaves following defoliation (a process referred to as refoliation). Generally, a tree refoliates when approximately 60 percent of its canopy is consumed. Production of a new set of leaves following defoliation restores the photosynthetic capability of a tree's canopy, however, the refoliation process draws upon nutrient reserves that would be used for shoot growth and foliage production the following spring. The refoliated canopy is not able to fully replace the nutrients and stored reserves mobilized by the tree during refoliation, leaving the tree in a weaker condition the following spring. As a result, trees exposed to repeated defoliation and refoliation are weaker and more susceptible to attack by wood-boring insects and root-decay fungi.

In the generally infested area or quarantine area where populations are treated to protect foliage, gypsy moth population densities fluctuate widely from year to year resulting in episodes of dramatic and severe defoliation followed by periods of relative innocuousness. At low densities, the gypsy moth is regulated, but not eliminated, by natural enemies such as parasitic insects and predaceous vertebrates, particularly small mammals. As populations increase beyond the control of these natural enemies, the gypsy moth is regulated by different mortality factors, primarily diseases and starvation. Of these two factors, diseases caused by the nucleopolyhedrosis virus (gmNPV) and the gypsy moth fungus (Entomophaga maimaiga) lead to the collapse of outbreak populations of gypsy moth. At the forest stand level, the period between outbreaks may range from 2 to 5 years and the actual outbreak period may range from 1 to 3 years. On a region-wide basis, gypsy moth populations develop to outbreak levels across wide areas of the northeast, mid-Atlantic, and Lake States for a

period of years and then drop to very low levels for several years. Factors regulating these regional outbreaks and collapses of gypsy moth populations are not well understood.

In response to concerns that the U.S. Department of Agriculture (USDA) was not adequately addressing the apparent increase in spread rates over the past three decades (Liebhold and others 1992), the USDA Forest Service (FS) in cooperation with Animal and Plant Health Inspection Service (APHIS); the states of Michigan, West Virginia, Virginia, and North Carolina; and the National Park Service, embarked on a pilot project called "Slow the Spread" (STS). The STS goal is to determine the feasibility of reducing the rate at which gypsy moth is currently spreading, by comprehensively implementing integrated pest management strategies over large geographic areas in the transition zone. As of this writing, evaluation of the STS project indicated that estimated spread rates significantly declined from an average of 26.5 km/yr prior to 1990 to 8.6 km/yr after 1990 (Sharov and Liebhold 1998) and STS has been integrated into USDA's national management strategy for gypsy moth.

Gypsy Moth Slow the Spread

Assuming the gypsy moth spreads at a rate of approximately 12 miles per year, it is expected to reach the Daniel Boone National Forest within 3 to 13 years (2005 to 2015). "Slow the Spread" is a national strategy designed to impede the spread of the gypsy moths by preventing low-density populations from becoming established and/or rapidly increasing. Slow the Spread employs intensive monitoring and aggressive management of gypsy moth populations that are increasing within the transition area (50 to 100 miles ahead of the front). The objective is to delay the impacts and costs associated with gypsy moth outbreaks and suppression. Figure 3 - 36 shows a projection of gypsy moth spread with the Slow the Spread strategy in place and without the Slow the Spread strategy.

States neighboring Kentucky to the east and northeast (Ohio, West Virginia, and Virginia) have suffered from defoliation caused by the gypsy moth (Table 3 - 36). These states are active in suppression efforts as described in the Gypsy Moth Environmental Impact Statement 1995 (Forest Health Protection 2002a, p.7).

Table 3 - 37 displays the results of annual monitoring of gypsy moth traps in high-use areas of the DBNF.

Isolated male gypsy moths have been captured, apparently arriving here while attached to vehicles that traveled from gypsy moth infested areas. At present there are no known reproducing populations in Kentucky.

Table 3 - 36. Aerially detected gypsy moth defoliation, 1996-2000.

STATE	1996	1997	1998	1999	2000
Ohio	49,000	5,000	1,600	48,200	23,600
Virginia	0	0	0	0	71,000
West Virginia	70,700	500	800	0	323,100
14 Other States	80,000	41,800	360,900	476,600	1,205,800
Total	199,700	47,300	363,300	524,800	1,623,500

(Forest Health Protection 2002a, p.7)

Table 3 - 37. Results of gypsy moth pheromone trapping on the DBNF, FY-2001.

District	Pheromone Trapping No. & Sex of Moths Captured	Delimited Grid Trapping No. & Sex of Moths Captured
Morehead	1 – Male	Not trapped
Stanton	0	Not trapped
London	1 – Male	0
Somerset	0	Not trapped
Stearns	0	Not trapped
Redbird	0	Not trapped

A gypsy moth risk rating system has been developed for use with the Continuous Inventory of Stand Conditions (CISC) maintained by the DBNF. This risk rating system was developed by entomologists at the Forest Health Protection field office in Asheville, NC. The model utilizes variables such as Forest Type, Condition Class, Site Index (a measure of site productivity) and Age to assign a risk to each stand. Risks are categorized as Unaffected, Low, Moderate, High, or Extreme. This model was applied to the Daniel Boone National Forest CISC information. Currently, approximately 23 percent of National Forest System land on the DBNF is at high to extreme risk of suffering damaged or death from gypsy moth attack. Figure 3 - 35 displays the existing condition pertaining to these gypsy moth risks. The spread of gypsy moth is projected in Figure 3 - 36.

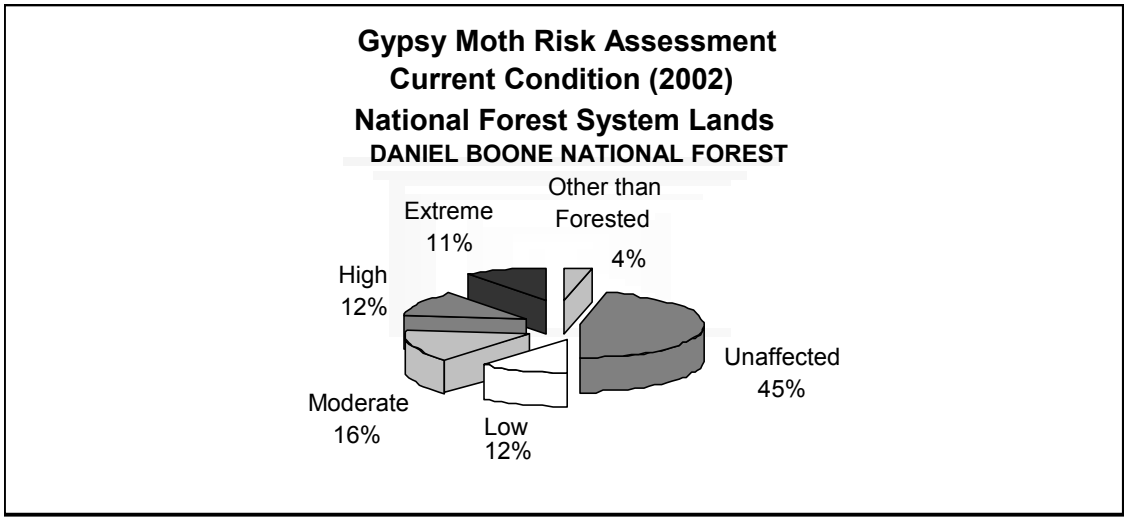

Figure 3 - 35. Gypsy moth risk assessment for the Daniel Boone National Forest.

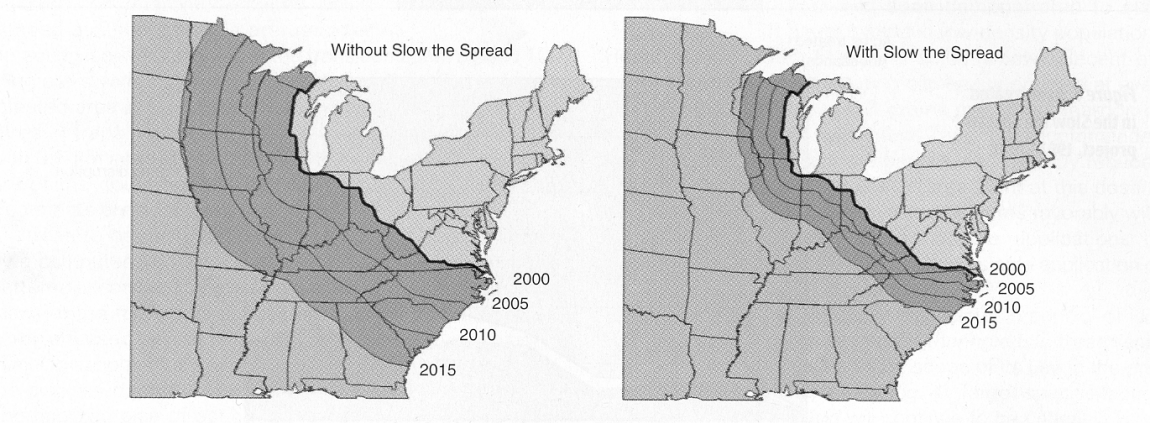

Figure 3 - 36. Projected gypsy moth spread in the Eastern United States. (Sharov et al. 2002, p. 34).

(Non-native) Hemlock woolly adelgid was brought to the eastern United States near Richmond, Virginia from Asia in 1927. The adelgid was present on some non-native tree species that a private collector planted in his arboretum. Distribution remained localized until the 1960s. The population has since spread west throughout the Shenandoah Valley into the Blue Ridge Mountains of Virginia, south into North Carolina, South Carolina, and Tennessee and north into the northeastern United States. Impacts can be severe. The entire range of eastern and Carolina hemlock could become infested within 30 years. Any hemlock tree is vulnerable, regardless of aspect, site conditions, or tree age. Once infested, tree mortality usually occurs in less than seven years. Considering known locations of the adelgid, it is expected to spread into Kentucky within the next 3 to 5 years (2005 to 2008).

(Non-native) Kudzu was introduced into the United States at the Philadelphia Centennial Exposition in 1876 where it was used as an ornamental, covering walkways and running through trellises. It was also recommended as a forage plant at that time. It was not until 1933 that the Soil Erosion Service (later named the Soil Conservation Service and now the National Resources Conservation Service) began distributing kudzu as a soil stabilizer (approximately 85 million plants were distributed). In 1953 the U.S. Department of Agriculture removed kudzu from its listings of cover plants, and in 1970 listed it for the first time as a common weed in the South.

(Non-native) Asiatic or oriental bittersweet is a deciduous woody vine that climbs by twining about a support. It is native to temperate East Asia, including central and northern Japan, Korea, and China north of the Yangtze River. Bittersweet appears to have been introduced to eastern North America around 1860. It is especially troublesome in the southern Appalachians. Its North American habitat preferences are wide but seem to be exclusively terrestrial. It is variously described as occupying open woods and thickets, roadsides, fencerows, and alluvial woods (Dreyer 1994). At present, oriental bittersweet is known in several small areas on the Morehead and Stanton districts.

(Non-native) Japanese knotweed is native to eastern Asia. It was introduced from Japan to the United Kingdom as an ornamental in 1825 and to North America in the late nineteenth century. Its early emergence and height growth combine to shade out other vegetation and prevent regeneration of other species. It does not appear to be a threat in undisturbed forests or in other low-light areas. If

unchecked, it will likely continue to expand its range in open habitats (Seiger 1991). Currently, Japanese knotweed has been located only on the Stearns district.

(Non-native) Nepalese browntop is also commonly referred to as Japanese grass or Eualia. An annual grass native to Asia from India, Japan, China, Korea, and Malaysia, it was first identified in the United States in 1919. It grows quickly, fruits within a single season, produces abundant seed, and easily invades disturbed areas, including areas disturbed by water along streams. Tolerant to shade, it does not persist in areas of full sunlight. Once established, however, it is difficult to eradicate (Tu, undated). Nepalese browntop has been found Forestwide.

(Non-native) Musk thistle, native to Europe and Asia, arrived in the United States during the mid-1800s. Musk thistle is most prevalent in disturbed areas and native grasslands (Heibel 1987). Musk thistle has been found on the Morehead district.

(Non-native) Spotted knapweed a native of Europe was accidentally introduced to North America in the 1890s in alfalfa seed from Asia Minor (Mauer et. al. 1987). Spotted knapweed tolerates shade but invades grasslands, displacing native grasses. Knapweed has been found on the London district.

(Non-native) Crown vetch is native to Europe, southwest Asia and northern Africa. Crown vetch is widely distributed throughout the northeastern United States, mostly from being planted along highways. Primarily a species of open, disturbed sites, it tolerates light to moderate forest shade. Currently, crown vetch has been found on the Morehead and London districts.

(Non-native) Zebra mussel, native to Eastern Europe, first entered the United States in the mid 1980s. Currently, zebra mussels have been found in Lake Cumberland.

(Non-native) Asian clam, a native of Asia, was introduced to North America around 1920 in the northwest. Since then, it has invaded nearly every major river system in the United States and is found throughout the DBNF.

(Native) Southern pine beetle, a native species, is a threat to shortleaf, pitch, and Virginia pine trees. Beginning in 2000, several Appalachian states with southern-yellow pine trees experienced extremely high populations of the southern pine beetle (Table 3 - 38). This will likely be known as one of the largest such outbreaks in the history for this region.

Table 3 - 38. Acres (thousands) of Southern Pine Beetle outbreaks, 1996-2000*.

STATE	1996	1997	1998	1999	2000	2001
Kentucky	0	0	0	0	220	100,000
13 Other States	7,301	8,477	6,820	6,159	11,912	Unknown
Total	7,301	8,477	6,820	6,159	12,132	

*Based on change detection analysis using satellite imagery. USDA Forest Service 2002a, p.7

As the southern pine beetle populations expanded the DBNF, southern-yellow pine trees died at an alarming rate. The infestation did not begin as individual spots that progressed across the landscape, but rather as thousands of widespread spots that expanded in all directions. Suppression efforts were largely ineffective. Even isolated southern-yellow pine trees, eastern white pine, and hemlock trees became infested and died. By 2002, populations of predator beetles were on the increase, and a noticeable decrease in southern pine beetle activity was evident.

The southern pine beetle infestation and massive tree loss has altered nearly 100,000 acres of upland stands in which southern-yellow pine was a component. Observations by field-going personnel indicate that individual live pine trees remain scattered across the landscape. Planting efforts can restore the southern-yellow pine component, but in the absence of human intervention, hardwoods are replacing dead pine trees.

(Native) Oak decline is a concern for upland hardwood forests throughout the Appalachian range. Stand and site factors that determine oak decline risk include forest type (oak density), site productivity (site index), age, and stress factors such as spring defoliation and drought. Red oaks are especially vulnerable. The red-oak borer is a contributing factor in widespread, severe mortality due to oak decline in Arkansas and could become a danger in Kentucky because of similar forest types and stand conditions. Approximately 36 percent (250,000 acres) of the National Forest System lands on the DBNF have upland forest types at risk of oak decline. Thirty-nine percent (96,000 acres) can be classified as damaged, 24 percent (61,000 acres) can be classified as vulnerable, and 37 percent (93,000 acres) can be classified as unaffected.

(Native) Oak Decline and Red-oak Borer: Oak decline is the culmination of three groups of interacting factors. The first group, termed *predisposing* factors, includes advanced physiologic age, tree species composition, tree density, and soil attributes. The second group, or *inciting* factors, includes drought and spring defoliation by frost or insects such as the gypsy moth or fall cankerworm. The third group is *contributing* factors such as armillaria root disease (caused by *Armillaria mella* (Vahl.) Quel.), two-lined chestnut borer, and the red oak borer. While contributing factors often appear to be the proximal cause of tree mortality in oak decline events, predisposing and inciting factors set the stage for the action of opportunistic pathogens and insects that infect the roots and girdle stems of vulnerable trees.

(Non-Native) Beech bark disease, a disease complex resulting from the interaction of multiple insect and fungus species that has caused extensive mortality of American beech in the northeastern United States. Beech bark disease results in mortality especially of large, old beech trees and heavy sprouting of highly susceptible stems that creates a stunted thicket growth of poorly-formed trees termed the "aftermath forest." Wounds created by feeding of the primary scale insect, Cryptococcus fagisuga, create infection courts suitable for colonization by several native and non-native species in the genus Neonectria (Primary native fungus is N. galligena and the primary non-native fungus is N. coccinea var. faginata.) A number of other related and un-related insects and fungi may be involved in the beech bark disease complex. Currently, 3,000 acres of forest on the DBNF is at risk to beech bark disease but management for the disease will be impractical until the disease becomes introduced and the relative abundance of resistant trees can be estimated.

Overstory vegetation

Over-mature trees[6] typically have a slower growth rate and less ability to withstand stress events than younger trees. In forest types found on the DBNF, culmination of periodic annual increment generally occurs 80 years after stand establishment. Nearly 44 percent (308,000 acres) of existing forest stands within the DBNF proclamation area have an average tree age of 80 years or greater and this is expected to increase to 58 percent (408,000 acres) over the next 10 years. This abundance of

[6] A tree or stand that is declining in commercial value (see glossary).

over-mature trees will result is an elevated risk of mortality to a number of abiotic and biotic stress events across the landscape.

Tree density

Trees in dense, over-stocked growing conditions typically exhibit lowered radial growth and have poorer live-crown development when compared to trees in fully stocked or open-grown conditions. In dense stands, reductions in photosynthetic potential results in increased susceptibility to stress events such as insect and disease outbreaks until tree mortality naturally thins stands or trees are thinned as part of active management. There are indications that much of the forest may be in an overstocked condition (Alerich 1991). Although current inventory data does not yield accurate estimates of forest densities, future surveys should be able to monitor this condition.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Richness

The six major forest types would continue to be present. None of the alternatives contain direction that would eliminate or add major forest types.

Native and Non-native Invasive Species

Hemlock woolly adelgid: Young and old hemlock trees whether healthy or damaged are equally susceptible to the hemlock woolly adelgid. Hemlock trees dominate a large part of riparian areas across the forest, some as scattered individuals and some as dense stands. While the hemlock woolly adelgid may not move rapidly through the DBNF in the manner of the southern pine beetle, it could still claim thousands of hemlock trees in the long-term. Prescribed fire could eliminate or prevent establishment of hemlock on the slopes where they would be susceptible to attack. Hemlock trees would still likely occur in riparian areas where fire is less intense during prescribed burns. The relative amount of fire among the alternatives would not change when the hemlock woolly adelgid arrives in Kentucky.

Kudzu: Patches of kudzu would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, kudzu would continue to spread, climbing trees and shrubs and shading out native vegetation. Repeat treatments would be needed to limit growth or eliminate a patch.

Asiatic Bittersweet: Patches of Asiatic bittersweet would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, Asiatic bittersweet spreads rapidly because of high reproductive rate, long-range dispersal from birds and small mammals, ability to sprout from roots, and rapid growth rate. The twining and climbing action of Asiatic bittersweet causes plants to be overtopped and girdled, resulting in death to plants.

Japanese Knotweed: Patches of Japanese knotweed would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Where action is not taken, Japanese knotweed would remain. It would not invade the forest understory because it requires high light environments for survival. Repeat treatment would be needed to prevent reestablishment.

Nepal Browntop: Patches of Nepal browntop would be monitored and occasionally, suppression activities would occur. Complete eradication is unlikely because it produces abundant seed that remains viable in the soil for up to five years. Nepal browntop can quickly crowd out natural communities, mostly in moist disturbed areas. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Musk Thistle: Patches of musk thistle would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Musk thistle occurs in disturbed areas such as roadsides and grasslands, crowding out natural communities.

Spotted Knapweed: Like many noxious weeds, initial invasion usually correlates with highly disturbed areas. Once established, it can invade relatively undisturbed areas. Patches of spotted knapweed would be monitored and occasionally suppressed. Complete eradication is unlikely during the next 10 years. Spotted knapweed has been found in grassland areas that are usually over grazed. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Crown Vetch: Like many noxious weeds, initial invasion usually correlates with highly disturbed areas. Once established, it can invade relatively undisturbed areas. Patches of crown vetch would be monitored and occasionally suppressed. Complete eradication would be unlikely during the 10 years. Crown vetch has been found in grassland areas. It tolerates light to moderate shade and will survive and spread under open forest cover. Repeat treatments would be needed to limit patch growth or to eliminate a patch.

Zebra mussel: No action would be taken because scientists at present have no means of eradicating zebra mussels.

Southern Pine Beetle: A wide spread infestation of southern pine beetle is unlikely in the next 10 years. Isolated spots may be active from year to year depending on climatic conditions, predator populations, and stress to pine trees.

Asian clam: Asian clams are present throughout the DBNF and no effort would be made to eradicate the species.

Beech bark disease: Age, size, and density of beech trees are factors that determine vulnerability and susceptibility. Beech bark disease is expected to be present on the forest within 10-20 years. Once established, the rate of spread will depend on beech stocking and how well the beech scale is able to spread. Many stands of large, old beech occur in the Upper Kentucky River Management Area, unfortunately, the highest mortality from beech bark diseases occurs with older, larger trees. The general forest trend toward an older-aged forest in all of the alternatives will result in enhanced risk to mortality from beech bark disease. Until beech bark disease becomes established, management for the disease in each alternative is impractical until more knowledge about distribution of resistant trees within the DBNF can be obtained. Prescribed burning is one tool that can be used to control heavy sprouting in beech bark disease-affected stands and to prevent beech from becoming established in new stands.

CUMULATIVE EFFECTS

Richness and Evenness

Outside actions by the private sector or by other agencies are unlikely to change the number or condition of the major forest types on the DBNF.

Native and Non-Native Invasive Species

Non-native invasive species can be transported into the area by vehicles, birds, livestock, equipment, and by people seeding disturbed areas on private land. If these areas are near National Forest System land, there is a chance for invasive species to spread onto the forest. Movement of boats from lakes containing zebra mussels can bring them to uninfested lakes. Vegetation management on private land can affect the presence and populations of insects and disease in the area. Road maintenance along state and federal highways can cause seed to move during grading operations. The differing emphasis on recreation among alternatives could have some impact on the spread of invasive species. Increased out-of-state travel could increase the likelihood of importing invasive species. Arrival of an invasive species could result from a single incident, however, regardless of the emphasis placed on recreation.

Activities in other states to suppress gypsy moth populations would be a factor in determining when the front reaches Kentucky, including the DBNF. Vehicles traveling from gypsy moth infested areas could bring gypsy moth into Kentucky. Gypsy moth occurrences are more likely to occur in developed campgrounds and parking areas. Activities designed to improve tree growth and develop advanced regeneration of oaks on National Forest System land, however, would not be sufficient to replace the aging upland hardwood forest types that would be affected by gypsy moth. Activities on private land are unpredictable and are not normally designed to defend against gypsy moth movement.

Physical Tree Features, Including Overstory

Occurrences of wildland fire are unpredictable, mostly a result of arson. The potential for damage to hardwood trees from wildland fire is related to the amount of land burned each year and the conditions at the time of the burn. Quantification of the damage that would be caused by wildfire cannot be predicted accurately.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration following the southern pine beetle infestation, would be expected to occur on approximately 21,000 acres (2,083 acres annually). Prescribed burning would be expected on approximately 150,000 acres (15,000 acres annually), mostly in forest types containing a pine component. These two activities should maintain or restore approximately 25,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession and management activities are expected to contribute toward changes in the vegetative component of the major forest types. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 90,000 acres (9,000 acres annually). These treatments would occur in the 1985 Plan's Management Areas 6 and 7, which encompass approximately 87 percent of the National Forest System land base. In 1985 Plan's Management Areas that are unsuitable for timber production, the tree species composition would move toward densely stocked, late-successional maple and beech.

Native and Non-native Invasive Species

Gypsy moth: By 2012, approximately 54 percent (145,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth infestation. This would be a five percent decrease from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area (50 to 100 miles ahead of the front) (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 45,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (from 157,000 to 189,000) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 22 percent (145,000 acres) of the DBNF would be susceptible (vulnerable or damaged condition) to oak decline, a 2 percent decrease from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 15,000 acres over the next 10-years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. With 15,000 acres burned annually, mostly within the pine-dominated region, little impact to hardwoods would be expected.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 4,000 acres (436 acres annually). Prescribed burning would be expected on approximately 20,000 acres (2,377 acres annually), mostly in forest types containing a pine component. These two activities should maintain or restore approximately 5,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 10,000 acres (1,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 68 percent (181,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, a 9 percent increase from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of 9,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (157,000 to 189,000 acres) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 27 percent (145,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, a 3 percent increase from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 15,000 acres over the next 10 years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. With 2,000 to 15,000 acres burned annually, little impact to hardwoods would be expected.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE C, C-1, & D

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 8,000 acres (822 acres annually). Prescribed burning would be expected on approximately 150,000 acres (15,000 acres annually). These two activities should maintain or restore approximately 10,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 60,000 acres (6,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 60 percent (160,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, a one percent increase from the 59 percent (157,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would be implemented to impede the gypsy moth advance by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 30,000 acres of upland hardwoods currently in the extreme-risk category would fortify them against gypsy moth attach, making them only moderately at risk. This analysis also accounts for 10 years of

growth that would move approximately 32,000 acres (157,000 to 189,000 acres) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 24 percent (160,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, an increase of less than one percent from the 24 percent (157,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning activities would occur on approximately 15,000 acres over the next 10 years. The water, nutrients, and light would be available to the remaining trees providing them with the opportunity to increase their crowns and roots. The live crown ratio on leave trees in thinned areas would be expected to increase. These conditions reduce the amount of stress to the remaining trees improving their ability to withstand stresses induced from invasive species.

The crowns of trees in dense stands that have not been thinned would become smaller as stands age. Some trees would die because their roots and crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand. However, with 15,000 to 50,000 acres burned annually, burning would occur in hardwood stands resulting in a noticeable increase in advance oak regeneration and elimination of thin-barked species. This thinning of the forest would encourage root and crown development of remaining trees. Signs of fire, such as basal scarring and possibly open wounds, especially in the younger hardwood stands, would be apparent.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Evenness

Pine restoration, following the southern pine beetle infestation, would be expected to occur on approximately 4,400 acres (436 acres annually). Prescribed burning would be expected on approximately 24,000 acres (2,400 acres annually). These two activities should maintain or restore approximately 5,000 acres of the pine and pine/hardwood as well as 48,000 acres of the hardwood/pine forest types that would otherwise convert to a hardwood forest type.

Over time (50 to 100 years), natural succession would favor maple and beech. Management activities that manipulate vegetation (tree cutting and prescribed burning) would maintain or restore early successional tree species on approximately 80,000 acres (8,000 acres annually). Tree species composition would tend toward densely stocked, late-successional maple and beech on the remainder of the forest.

Native and Non-native Invasive Species

Gypsy moth: By 2012 an estimated 48 percent (130,000 to 268,000 acres) of upland hardwoods would be at high or extreme-risk to gypsy moth attack, an 11 percent decrease from the 59 percent (157,000 to 268,000 acres) currently at high or extreme-risk. Eradication and Slow-the-Spread strategies would impede the spread of the gypsy moth by preventing low-density populations from establishing and/or rapidly increasing. Steps would be taken to eliminate accidental introductions from becoming established. Also, Slow-the-Spread activities would employ intensive monitoring and aggressive management of gypsy moth populations within the transition area, 50 to 100 miles ahead of the front, (Gypsy Moth FEIS). Over the 10-year planning period, treatment of approximately 60,000 acres of upland hardwoods currently in the extreme-risk category would be fortified against gypsy moth attack, making them only moderately at risk. This analysis also accounts for 10 years of growth that would move approximately 32,000 acres (157,000 to 189,000) from the moderate-risk category (2002) into high or extreme-risk (2012).

Oak decline: By 2012 an estimated 19 percent (130,000/672,000 acres) of the Forest would be susceptible (vulnerable or damaged condition) to oak decline, a 5 percent decrease from the 24 percent (157,000/672,000 acres) currently susceptible.

Physical Tree Features, Including Overstory

Thinning would occur on approximately 24,000 acres over the next 10 years. The water, nutrients, and light available to the remaining trees would offer them the opportunity to increase their crowns and roots. An increased live crown ratio would reduce the strain on trees remaining in thinned areas, improving their ability to withstand stresses induced by invasive species.

The crowns of trees in dense stands not thinned would become smaller as the stands age. Some trees would die because their live crowns would not be capable of supplying the water and nutrients needed to maintain growth. In general, the Forest would have many areas of trees under stress from dense stocking and old age.

Prescribed burning would encourage advance oak regeneration and eliminate thin-barked species such as maple, beech and hemlock. Because prescribed burning would occur at a landscape scale, making use of existing control lines where possible, pole stands of hardwood could receive some damage. The bark on trees within pole-sized stands may not be thick enough to withstand fire, resulting in basal wounding and open scars. Some trees could die, a positive result if they were not a desired component of the stand.

CUMULATIVE EFFECTS

There would be no additional effects beyond those already disclosed.

VIABILITY

Affected Environment

The viability of species native to the DBNF or within the influence of the Forest (the proclamation boundary) was addressed in a multiple step process. An extensive list of species found on or near the Forest was developed from literature, sight records, species location databases, consultation with other agencies, and the knowledge of Forest Service personnel. While this inventory includes about 3,800 species, not all species groups, e.g., insects and other arthropods are well represented, because documentation was not always available. At the same time, a list of major habitat associations and rare communities was developed. Then the catalog of species was filtered to identify keystone species and species with uncertain likelihood of continued viability, resulting in a list of 409 species[7]. This list is dynamic and the number of species on it is expected to change with updates of distribution and habitat and population condition data. Species with uncertain likelihood of continued viability are defined as those for which there is a low likelihood of maintaining viable populations within a defined area without management intervention. The National Forest Management Act (NFMA) defines a viable species population as "the estimated numbers and distribution of reproductive individuals to insure its continued existence [and] is well distributed in the planning area so that those individuals can interact" (36 CFR 219.19). Keystone species generally have stable populations and their viability is not of concern, but their existence in the ecosystem helps to ensure that one or more other species maintain viable populations.

Next, a list documenting the habitat relationships of these 409 species was compiled. A list of similar, associated habitats and their associated species was also developed, based on habitat-species relationships. Then, available data were utilized to estimate the types and amounts of habitat necessary to maintain minimum viability, i.e., the smallest population capable of sustaining itself for species with viability concerns. In the case of rarely occurring species this would mean the maintenance of existing populations and their required habitat.

If major habitat associations and rare communities can be maintained, adequate habitat should be available to maintain the viability of most species. Providing general forest type or structure condition, however, does not necessarily supply adequate habitat for every species. Those with highly specific habitats, low population numbers, or other factors potentially reducing the likelihood of continued viability may need closer examination and more precise habitat management.

For this analysis, the "planning area" referred to in the NFMA definition of viability consists of federally owned lands administered by the DBNF. The ability to sustain viable populations of native and non-native species of plants and animals is limited by the capabilities of the land and agency.

Because species and their environments are dynamic, it is not possible to ensure that a species will persist indefinitely. Likewise, there is no single, fixed size of a population above which a species is viable and below which it will become extinct (Boyce 1992), or in the case of the DBNF, extirpated. Consequently, viability is best expressed as a likelihood of continuance of a species in a particular area or the risk of a particular habitat-species relationship not being maintained on the ground.

[7] Consists of PETS and Conservation Species.

TERRESTRIAL SPECIES VIABILITY EVALUATION

National Forest Management Act (NFMA) regulations, adopted in 1982, require that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.19). USDA regulation 9500-004, adopted in 1983, re-enforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. These regulations focus on the role of habitat management in providing for species viability. Supporting viable populations involves providing habitat in amounts and distributions that can support interacting populations at levels that result in continued existence of the species well distributed over time.

The Southern Appalachian region supports extremely high levels of biological diversity compared to other regions, viewed both nationally and globally. As a result, large numbers of species are present for which population viability may be of concern. Detailed demographic or habitat capability analysis to evaluate population viability is not feasible for such a large number of species. Therefore, our goals for this evaluation are:

1) To use a clearly defined, transparent process to identify species for which there are substantive risks to maintenance of viable populations, and

2) To ensure consideration of appropriate habitat management strategies to reduce those risks to acceptable levels where feasible.

For comprehensiveness and consistency, evaluation of species viability was coordinated across several national forests undergoing simultaneous plan revisions. Species lists from the DBNF were compared with lists from the Jefferson National Forest, Cherokee National Forest, Sumter National Forest, Chattahoochee and Oconee National Forests, and National Forests in Alabama. These forests encompass portions of the Southern Appalachian, Piedmont, and East Gulf Coastal Plain ecoregions. However, the scale for this assessment is set by NFMA regulations as the "planning area," or the area of the National Forest System covered by a single forest plan. Therefore, separate risk assessment was done for each national forest covered by a separate forest plan. Although viability evaluation was coordinated across the ecoregions, analysis presented here focuses on information relevant to the DBNF.

Because NFMA regulations require the provision of habitat for species viability within the planning area, the focus of this evaluation is the habitat provided on National Forest System (NFS) land. Surrounding private lands may contribute to, or hinder, maintenance of species viability on NFS land, but surrounding lands are not relied upon to meet regulation requirements. For this reason, habitat abundance was assessed based on conditions found on NFS land. Habitat distribution, however, was assessed considering the condition of intermixed ownerships and conditions, which may affect the interactions of species among suitable habitat patches on NFS land.

Evaluation of migratory birds focused on breeding populations only, unless otherwise indicated. This focus does not mean that wintering and migrating populations were not considered during planning, but that viability evaluation makes most sense when viewed in terms of the relative stability of breeding populations.

Much of the foundational information used in this evaluation was compiled by NatureServe under a Participating Agreement with the Forest Service. NatureServe is an international non-profit organization, formerly part of The Nature Conservancy. Its mission is to develop, manage, and

distribute authoritative information critical to conservation of the world's biological diversity. Partnership with NatureServe was sought as a means to obtain the best available information on species status and habitat relationships for use in this evaluation. Under this agreement, NatureServe staff engaged numerous species experts and state heritage programs to develop a relational database that includes relevant information on species' status, habitat relationships, and threats to viability.

VIABILITY EVALUATION PROCESS

Risk to maintenance of viability over the next 50 years was assessed for each species in relation to each of its principle habitat relationships by alternative. Risk assessment was based on three factors: 1) current species abundance, 2) expected habitat abundance in 50 years, and 3) expected habitat distribution in 50 years (Figure 3 - 37). Once risk ratings were developed, how well management strategies would provide for species viability was assessed by alternative.

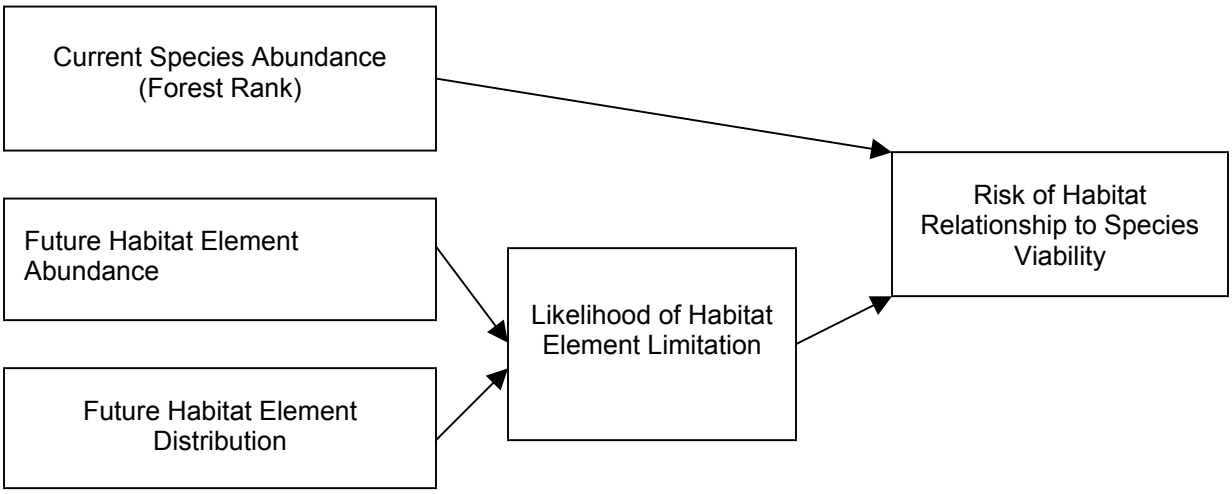

Figure 3 - 37. Relationship of variables used to rate the risk to viability resulting from a species' relationship with a habitat element.

A comprehensive list of species with potential viability concern was compiled for the DBNF. The list includes those species found, or potentially found, on the Forest from the following categories:

1) Species listed as proposed, threatened, or endangered under the federal Endangered Species Act
2) Species listed on the Regional Forester's Sensitive Species list
3) Species identified as locally rare on the DBNF by Forest Service biologists
4) Birds of conservation concern as identified by the U.S. Fish and Wildlife Service
5) Declining species of high public interest.

Species lists from all national forests in the Southern Appalachian, Piedmont and Cumberland Plateau ecoregions, as well as Coastal Plain forests in Alabama, were pooled to create comprehensive lists of species of potential viability concern. NatureServe staff and contractors assigned abundance ranks for each species on the comprehensive ecoregion list for the DBNF. These Forest Ranks, or F Ranks, follow the conventions used by NatureServe and others in defining State

and Global Ranks. F Ranks were used in viability risk assessment as a categorical variable representing a species' current abundance. Forest Service biologists reviewed F Ranks developed by NatureServe to identify any inconsistencies between these rankings and Forest Service information. Many discrepancies in this abundance variable were resolved through coordination with NatureServe; however, some differences remain due to disagreement among experts or inconsistencies in source data. Efforts to resolve these differences are ongoing. For this analysis, where conflicting information on species abundance occurs, the most conservative information (i.e., that indicating lowest abundance) was used.

Only those species that are both confirmed present and rare or of unknown abundance (F1 through F3, and F?) on the DBNF were assessed for viability risk. Species ranked as F? were treated as F1 species to provide a conservative approach to those species for which abundance information is not available. Species currently abundant on the forest (F4, F5) are assumed to be at low risk of losing viability within the next 50 years, and, therefore, were not further evaluated for viability risk.

Table 3 - 39. Forest Ranks (F Rank) and definitions used to define status of species on the DBNF as part of species viability evaluation for Forest Plan revision, 2002.

Forest Rank	Forest Rank Definition
F0	Not present; no known occurrences on the Forest unit, and Forest is outside species' range or habitat not present.
F1	Extremely rare on the Forest unit, generally with 1-5 occurrences.
F2	Very rare on the Forest unit, generally with 6-20 occurrences.
F3	Rare and uncommon on the Forest unit, from 21-100 occurrences.
F4	Widespread, abundant, and apparently secure on the Forest unit.
F5	Demonstrably secure on the Forest unit.
F?	Present on the Forest, but abundance information is insufficient to develop rank.
FP	Possibly could occur on the Forest unit, but documented occurrences are not known.
FH	Of documented historical occurrence on the Forest unit; may be rediscovered.
FX	Once occurred but has been extirpated from the Forest unit; not likely to be rediscovered.

Because viability regulations focus on the role of habitat management in providing for species viability, habitat condition was the primary factor used to drive species viability evaluation. NatureServe staff and contractors identified habitat relationships for all species of potential viability concern, linking each species to vegetation community types, forest age, and habitat attributes as appropriate. Based on this information, each species was linked by Forest Service biologists to one or more habitat elements. These habitat elements (Table 3 - 40) roughly correspond to categories of management direction included in the Proposed Revised Forest Plan, and to sections of effects analysis included in this draft environmental impact statement (DEIS). NatureServe staff reviewed and provided adjustments to species' assignment to these habitat element groups.

Table 3 - 40. Habitat elements used to plan for, and assess risk to, viability of terrestrial species during DBNF Forest Plan revision.

HABITAT ELEMENT	ELEMENT DESCRIPTION
Bogs, Seeps, Seasonal Ponds	Bogs, seeps, seasonal ponds characterized by saturated soils
Open Wetlands	Open wetlands, marshes, beaver ponds, generally characterized by having some permanent standing water (includes swamps)
River Channels	Riverine gravel and sand bars, and river banks subject to flood scour
Glades and Barrens	Glades and barrens characterized by shallow soils, exposed parent material, and sparse or stunted vegetation
Rock Outcrops and Cliffs	Rock outcrops and cliffs characterized by exposed rock, shallow soils and sparse vegetation
Spray Cliffs	Rock that remains wet for all or most of the year, associated with waterfalls or seepage
Canebrakes	Canebrakes characterized by dense stands of cane and open canopies, usually within riparian areas
Caves	Caves with microclimates capable of supporting associated biota
Dry-Xeric Cedar Oak Forest	70+ year old redcedar and mixed oak forest with open midstory and understory.
Mature Forests (General)	70+ forest of any type
Mature Mixed Mesophytic Forests	70-140+ year old mixed mesophytic (cove) forest, characterized by calciphilic herbs and usually dominated by sugar maple, American basswood, and yellow buckeye
Mature Hemlock Forests	80-140 year old + eastern hemlock and eastern hemlock-white pine forests in native settings, typically on stream terraces and other mesic sites
Mature/ Old-Aged Beech Forests	Forests dominated by 80 year old + American beech, usually in coves or riparian areas
Mature Mesic-Xeric Oak Forests	Mesic to xeric 70-120 + year old oak and oak-yellow pine forests subject to moderate levels of disturbance (fire) sufficient to maintain the oak component
Mature Yellow Pine and Mixed Yellow Pine-Oak Forests	70-120 year old southern yellow pine and pine-oak forests maintained in open conditions by frequent fire
Mature Pitch Pine Forests	70-120 year old pitch pine or pitch pine-mixed yellow pine-oak forests, primarily on ridges and along cliffs. Maintained in open conditions by frequent fire
Mature High Elevation Mesic Hardwood (Pine Mtn.)	70+ year old mesic hardwoods at 2300 ft elevation or higher
Mature Forest Interiors	Mature forest interiors with minimal adverse effects due to forest edge.
Mid-Aged Forest	Forest 11-60 years old, often with high stem density
Young Age Forests	Young age forests, typically aged 0-10 years and dominated by woody species
Young Age Yellow Pine and Mixed Yellow Pine-Oak Forest	Young age yellow pine and yellow pine-oak forest, typically 0-10 years old and dominated by woody species.
High Elevation Early-Aged Forest (Pine Mtn.)	Young age forest at 2300 ft elevation or higher
Canopy Gaps	60-140 year old mesic, deciduous, and 60-120 + year old dry-mesic oak forests with a diverse vertical and horizontal structure as a result of gaps in the canopy
Woodland	Open, moderate basal area with either grass/forb or low shrub understory
Wooded Grassland/Shrubland	Open, low basal area with either grass/forb or low shrub understory
Grass/Forb Woodlands and Wooded Grasslands	Open woodlands and wooded grasslands characterized by low canopy cover and species rich, grass-dominated understories, and maintained in open conditions by periodic fire
Grasslands	Grasslands with little to no overstory, usually occurring as patches within woodland and wooded grassland complexes and maintained by periodic fire
Fire Adapted/Enhanced	Species promoted by fire or fire maintained conditions
Riparian (General)	Riparian forest, open or closed and a variety of understory conditions
Open Midstory and Understory	Forest, generally mid-aged or older in which the midstory and understory are open and often sparse
Dense High Shrub Understory	Forest, generally mid-aged or older in which the understory is thick with woody species 6-10 ft tall
Mature/ Old-Aged Riparian	Riparian areas dominated by 70-120 year + deciduous and mixed conifer-hardwood forests
Young Age Riparian	Riparian areas with a dense understory or young age forest in riparian areas
Snags	Forests containing an abundance of snags
Den Trees	Trees with small to large cavities in which species may winter, seek protection or house young
Old-Aged Forest with Dead/Dying Large Trees	120-150 year old + forest characterized by having numerous large dead (snags) or dying trees
Downed Wood	Forests containing an abundance of downed wood and thick leaf litter
Hard Mast	Forests producing abundant hard mast
Lakeshores, Large Reservoirs	Forested shores of lakes
Pond Shore	Shores of ponds, usually grassy or shrubby
Water (Distance Sensitive)	Source of free water is needed with a specific distance during the entire year or specific portions of the year

Effects to these habitat elements are analyzed in this DEIS under other sections. Based on these analyses, each habitat element was assigned categorical values by alternative to indicate:

1) Future abundance (Table 3 - 41) and distribution (Table 3 - 42)
2) General likelihood that the habitat element would limit viability of associated species (Table 3 - 43)
3) Overall effect of national forest management on the habitat element (Table 3 - 45).

The future abundance variable (Table 3 - 41) is defined as the likely abundance of the associated habitat element in 50 years if the alternative were selected and implemented over that 50-year period. This variable indicates the abundance of the habitat element on National Forest System land only, to provide focus on the role of the national forest planning area in supporting associated species. Definitions of abundance categories are stated in quantifiable terms in order to be objective as possible; however, in many cases quantifiable estimates of future abundance are not available. In these cases, knowledge of Forest Service biologists was used to assign abundance values based on current conditions plus the magnitude and direction of effects expected under each alternative.

Table 3 - 41. Values used to categorize projected abundance of each habitat element after 50 years of implementing each alternative.

Habitat Abundance Value	Description
Rare	The habitat element is rare, with generally less than 100 occurrences, or patches of the element generally covering less than 1 percent of the national forest planning area.
Occasional	The habitat element is encountered occasionally, and generally is found on 1 to 10 percent of the national forest planning area.
Common	The habitat element is abundant and frequently encountered, and generally is found on more than 10 percent of the national forest planning area.

Similar to the future abundance variable, the future distribution variable (Table 3 - 42) is defined as the likely distribution of the associated habitat element in 50 years if the alternative were selected and implemented over that 50-year period. In contrast to the abundance variable, it includes consideration of intermixed ownership patterns and conditions, as well as their general effects on movements and interactions of individuals among the suitable habitat patches found on NFS land.

The number of species to be evaluated is very large, and the knowledge level required to assess habitat adequacy for most species is not available. However, habitat distribution can be assessed in historical terms. Conditions that existed prior to the major perturbations associated with European settlement of the planning area, generally defined as 1000 to 1700 A.D., provide this reference. This approach assumes that habitat distribution similar to that which supported associated species during relatively recent evolutionary history will likely contribute to their maintenance in the future. Accordingly, the viability risk of associated species rises as habitat departs from that historical distribution.

This approach has its own set of difficulties because evidence of pre-1700 conditions relevant to the planning area is scarce and often anecdotal. Some evidence does support the past occurrence of yellow pine forests as well as yellow pine and hardwood woodlands, wooded grasslands/shrublands, and smaller grasslands in the past 2,000 to 3,000 years on what is now the DBNF and adjacent areas (Campbell et al. 1991, Novi and Waldrop 1991, Delcourt et al. 1998, Delcourt, 2002, Owen 2002).

However, the extent of such habitats is not easily determined. The DBNF has a taken an adaptive approach plan for limited acreage in this planning cycle while projecting long-term, larger amounts (see Vegetation Cover section). In addition, the reference period may have included a wide variety of conditions as a result of growing aboriginal populations and accompanying use of agriculture and fire during the early portion of this period, and their subsequent dramatic decline due to disease epidemics following early European contact. Nevertheless, the precision required to assign the categorical values for this variable is not High, and may be supported by general positions described in mainstream conservation literature (see discussions in Baker and Hunter 2002; Owen 2002; Trani-Griep 2002). Knowledge of Forest Service biologists was used to assign distribution values, based on interpretations of historical conditions supported by conservation literature and current conditions, as well as magnitude and direction of effects expected under each alternative.

Table 3 - 42. Values used to categorize projected distribution of each habitat element after 50 years of implementing each alternative.

HABITAT DISTRIBUTION VALUE	DESCRIPTION
Poor	The habitat element is poorly distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is greatly reduced.
Fair	The habitat element is fairly well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is somewhat reduced.
Good	The habitat element is well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches is similar to or only slightly reduced relative to reference conditions.

Habitat element abundance and distribution variables were combined to create one variable to indicate the general likelihood that the habitat element would be limiting to populations of associated species (Table 3 - 43). In this general context, habitat limitation refers to a habitat factor -- quantity, distribution, or quality -- that results in risk to continued existence of the species within the planning area. Everything else being equal, quality habitat elements that are rare and poorly distributed are those most likely to cause risk to viability of associated species; those that are common and well distributed are least likely to cause risk to viability of associated species.

Table 3 - 43. Likelihood of habitat limitation (High, Moderate, and Low) to associated species as derived from habitat abundance and distribution values.

HABITAT ABUNDANCE	HABITAT DISTRIBUTION		
	Poor	**Fair**	**Good**
Rare	High	High	Moderate
Occasional	High	Moderate	Low
Common	Moderate	Low	Low

Providing for species viability requires providing abundant and well-distributed habitat in ways that allow existing populations to persist or expand. The ability of existing populations to respond to available habitat depends in part on their current robustness, which is generally a function of population size. In general, for a given habitat condition, small populations will be at more risk than

large populations. To reflect this fact, the "likelihood of habitat limitation" variable was combined with a species' F Rank for each species/habitat element interaction to generate viability risk ratings (Table 3 - 44). Associations of very rare species with habitat elements that are likely to be most limiting were identified as those most at risk; associations of more common species with habitats less likely to be limiting received lower risk ratings.

Table 3 - 44. Viability risk ratings for species/habitat interactions as a function of a species' F Rank and likelihood of habitat element limitation variables.

Likelihood of Habitat Element Limitation	Species F Rank		
	F1 or F?	F2	F3
High	Very High	High	Moderately -High
Moderate	High	Moderately-High	Moderate
Low	Moderately-High	Moderate	Low

Once viability risk ratings were developed for each species/habitat relationship, habitat elements most commonly associated with risks to species viability were identified by counting the number of Very High, High, and Moderately High ratings associated with each. To assess the role of national forest management in minimizing viability risk associated with each habitat element, a management effects variable was assigned to each habitat element by alternative. The management effects variable (Table 3 - 45) categorizes the goal of management for the habitat element, the expected resulting trend, and any additional opportunity for minimizing viability risk. Numbers of Very High, High, and Moderately-High risk ratings were summarized by management effects variable by alternative to assess how well alternatives address viability-related habitat needs.

Table 3 - 45. Values used to categorize the effect of national forest management in minimizing or contributing to species viability risk associated with each habitat element.

MANAGEMENT EFFECT VALUE	DESCRIPTION
1	Abundance and distribution of the habitat element is maintained or improved by providing optimal protection, maintenance, and restoration to all occurrences (with limited exceptions in some cases). Little additional opportunity exists to decrease risk to viability of associated species because management is at or near optimal. Pertains largely to inherently rare habitat elements.
2	Abundance and distribution of the habitat element is improved through purposeful restoration, either through active management or passively by providing for successional progression. Opportunity for decreasing risk to associated species is primarily through increasing rates of restoration, where possible. Pertains largely to potentially widespread habitat elements.
3	The habitat element is maintained at approximately current distribution and abundance, though location of elements may shift over time as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to increase abundance and distribution of the habitat element.
4	Regardless of management efforts, the habitat element is expected to decrease in distribution and abundance as a result of factors substantially outside of Forest Service control (e.g., invasive pests, acid deposition). Opportunity to reduce risk to viability of associated species is primarily through cooperative ventures with other agencies and organizations.
5	The habitat element is expected to decrease in distribution and abundance as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to maintain or increase this habitat element.

Distribution of viability risk was also summarized by species status, i.e., federally listed under the Endangered Species Act, listed as Regional Forester's sensitive species, identified as locally rare, or of other concern. The species status summary highlights the relative role of other provisions included in law and policy that result in additional consideration of at-risk species during planning.

Viability Evaluation Results

Species viability evaluation for the DBNF included consideration of about 3,800 species of the Cumberland Plateau ecoregion. Of these species, 266 from the Cumberland Plateau ecoregion are considered rare (F Rank of F?, F1, F2 or F3) and are known to occur on the Forest.

Outcomes for habitat elements, as described under individual effects analysis sections, are summarized in Appendix H, Table H - 1, using the four variables described in Table 3 - 41, Table 3 - 42, Table 3 - 43, and Table 3 - 45. These variables indicate expected habitat condition following 50 years of implementing each alternative.

Ratings of risk to viability for each species/habitat relationship by alternative are presented in Appendix H, Table H - 2. To facilitate comparison of effects of alternatives on species viability, the numbers of Very High, High, and Moderately-High risk ratings are summarized for each alternative by habitat element (Table 3 - 46), management effect (Table 3 - 47), and species status (Table 3 - 48).

Viability risk rating summaries indicate relatively small differences among alternatives relative to effects on species viability. This similarity results from planning efforts to include provision in all alternatives for species viability in compliance with NFMA regulations. Examples of such provisions common to all alternatives (except Alternative A, which represents the current forest plan) include the Rare Community Prescription Area and the Riparian Corridor Prescription Area. Similarity of viability outcomes among alternatives also results from the influence of external forest health threats, which represent serious risks to forest communities and associated species regardless of alternative. Differences among alternatives are also muted by the small scale of actions contemplated under all alternatives relative to the more extensive effects to ecological systems that have occurred to DBNF landscapes since European settlement. Broader scale effects will likely continue to have similar important effects to species viability regardless of alternative.

Evaluation results indicate, under all alternatives, that high levels of risk to species viability are associated with certain key habitats (Table 3 - 46). Highest risks are associated with:

1) Bogs, seeps, and seasonal ponds
2) Wetlands
3) Glades
4) Grass/forb woodland or wooded grassland
5) Mature yellow pine and mixed pine-oak forest
6) Mature hemlock-white pine
7) Mature high elevation mesic hardwood
8) Grassland.

Bogs, springs and seeps, and natural seasonal ponds are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to beaver

control and drainage for agriculture, and the number of rare species associated with them. The Rare Community Prescription Area should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Communities Prescription Area.

Wetlands, including swamps, natural upland ponds, beaver ponds, and wet meadows are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to beaver control and drainage for agriculture, and the number of rare species associated with them. The Rare Community and Riparian Corridor Prescription areas should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Community Prescription Area. In some cases, artificial wetlands which could be created under any alternative, may provide suitable, but not necessarily optimal habitat.

Glades are critical to maintaining species viability due to their natural rarity on the landscape, their decline during European settlement due to fire exclusion and changes in the nature and extent of herbivory (animal grazing) within them, and the number of rare species associated with them. The Rare Community Prescription Area should provide for optimal protection and management of all occurrences of these habitats under all alternatives except Alternative A; therefore, opportunities for further reducing risk to viability of associated species are limited. While such habitats would likely be maintained under Alternative A, they would not receive the focused attention provided by the Rare Community Prescription Area.

Grass/forb woodlands or wooded grasslands are critical to maintaining species viability due their rarity on the landscape, largely the result of changes in fire patterns and frequency on the landscape following both mid-16th century European contact and later settlement; and the number of rare species associated with them. Provisions of the habitat diversity prescription in Alternatives C, C-1 and D provide for the restoration of this habitat on about 10 percent of the DBNF after 50 years, a figure probably below the historical level, but almost in its entirety an increase over current conditions. The Custodial Area Prescription Area of Alternative B-1 and the Timber Production Emphasis Prescription Area of Alternative E-1 would provide for this habitat on less than 1 percent of the DBNF after 50 years. Under Alternative A, such habitats would not likely be restored.

Mature yellow pine and mixed pine-oak forests are critical to maintaining species viability for two reasons. They are naturally limited on the DBNF landscape, and a large number of species is associated with them. A recent outbreak of the southern pine beetle, of unprecedented severity, killed at least 70 percent of the yellow pines in yellow pine and yellow pine-oak forest. Currently this habitat is rare on the Forest. All alternatives provide for the establishment of new yellow pine forests, but none would in 50 years provide mature yellow pine, and none would replace in 50 years the yellow pine acreage lost to the pine beetle epidemic.

Mature eastern hemlock-white pine forests are critical to maintaining species viability because the hemlock component, which is most important, is naturally limited to riparian zones, narrow shaded hollows and high elevations, and represents the edge of range for many associated species. They therefore support large numbers of species of potential viability concern. While their distribution

may be somewhat reduced over historical conditions, the greatest threats to this community and associated species are impacts from the hemlock woolly adelgid, an invasive non-native insect expected to be on the DBNF within one to two decades. All age classes of hemlock are susceptible to this insect, and there is currently little which management can do to slow its spread. Additionally, impacts from air pollution may be adversely affecting this habitat; significant broad-scale coordinated efforts are needed to resolve this issue. Although core areas of eastern hemlock-white pine forest would be provided optimal management under both the Riparian Corridor and the Habitat Diversity Prescription Areas, external threats are more likely to determine the fate of this community as well as the viability of associated species. Little opportunity for reducing risks through typical national forest management is apparent.

Mature, high-elevation mesic hardwood forests are critical to maintaining species viability because they are naturally limited to the highest elevations and represent the edge of range for many associated species. They therefore support large numbers of species of potential viability concern. While their distribution may be somewhat reduced over historical conditions, the greatest threats to this community and associated species are impacts from mining, timber harvest, and development. Additionally impacts from air pollution may be adversely affecting this habitat; significant broad-scale coordinated efforts are needed to resolve this issue. Little of this habitat is managed by the DBNF, and a core area does not exist on the Forest. While core areas exist on other lands, external threats are more likely to determine the fate of this community and the viability of associated species. Little opportunity for reducing risks through typical national forest management is apparent.

Table 3 - 46. Number of species/habitat relationships rated as of Very High, High, and Moderately High risk to terrestrial species viability for each habitat element by alternative.

HABITAT ELEMENT		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Bogs, Springs, Seeps							
Very High		0	0	0	0	0	0
High		27	27	27	27	27	27
Moderately High		15	15	15	15	15	15
	Total	42	42	42	42	42	42
Wetlands							
Very High		8	8	8	8	8	8
High		7	7	7	7	7	7
Moderately High		6	6	6	6	6	6
	Total	21	21	21	21	21	21
Glades and Prairies							
Very High		3	3	3	3	3	3
High		3	3	3	3	3	3
Moderately High		5	5	5	5	5	5
	Total	11	11	11	11	11	11
River Channels							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		17	17	17	17	17	17
	Total	17	17	17	17	17	17

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Spray Cliffs						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Canebrakes						
Very High	0	0	0	0	0	0
High	1	1	1	1	1	1
Moderately High	0	0	0	0	0	0
Total	1	1	1	1	1	1
Caves						
Very High	0	0	0	0	0	0
High	4	4	4	4	4	4
Moderately High	4	4	4	4	4	4
Total	8	8	8	8	8	8
Cliffline						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	18	18	18	18	18	18
Total	18	18	18	18	18	18
Dry-Xeric Cedar Oak						
Very High	4	4	4	4	4	4
High	2	2	2	2	2	2
Moderately High	1	1	1	1	1	1
Total	7	7	7	7	7	7
Woodland						
Very High	0	0	0	0	0	0
High	1	1	0	0	0	1
Moderately High	0	0	0	0	0	0
Total	1	1	0	0	0	1
Wooded Grassland/Shrubland						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Grass/Forb Woodland or Wooded Grassland						
Very High	29	29	0	0	0	29
High	17	17	0	0	0	17
Moderately High	28	28	29	29	29	28
Total	74	74	29	29	29	74
Canopy Gaps						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	23	23	23	23	23	23
Total	23	23	23	23	23	23

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Mature Yellow Pine and Mixed Pine-Oak						
Very High	17	17	17	17	17	17
High	15	15	15	15	15	15
Moderately High	17	17	17	17	17	17
Total	49	49	49	49	49	49
Mature Pitch Pine						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	1	1	1	1	1	1
Total	1	1	1	1	1	1
Old-aged Forests with Dead/Dying Large Trees						
Very High	0	0	0	0	0	0
High	5	0	0	0	0	5
Moderately High	1	5	5	5	5	1
Total	6	5	5	5	5	6
Early-Age Yellow Pine and Mixed Pine-Oak						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Mature/Old-Aged Beech						
Very High	1	0	0	0	0	0
High	0	1	1	1	1	1
Moderately High	0	0	0	0	0	0
Total	1	1	1	1	1	1
Mature Hemlock-White Pine						
Very High	13	13	13	13	13	13
High	5	5	5	5	5	5
Moderately High	6	6	6	6	6	6
Total	24	24	24	24	24	24
Mature High Elev. Mesic Hardwood (Pine Mtn.)						
Very High	14	14	14	14	14	14
High	1	1	1	1	1	1
Moderately High	1	1	1	1	1	1
Total	16	16	16	16	16	16
High Elevation Early-aged Forest (Pine Mtn.)						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Mature Xeric-Mesic Oak						
Very High	0	0	0	0	0	0
High	0	14	0	0	0	0
Moderately High	14	14	14	14	14	14
Total	14	28	14	14	14	14

HABITAT ELEMENT		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Mixed Mesophytic Hardwood							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		21	21	21	21	21	21
	Total	21	21	21	21	21	21
Mature Forest Interior							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		10	10	10	10	10	10
	Total	10	10	10	10	10	10
Mature Forest (general)							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		34	34	34	34	34	34
	Total	34	34	34	34	34	34
Mature/Old-Aged Riparian Forest							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		10	10	10	10	10	10
	Total	10	10	10	10	10	10
Riparian (general)							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		9	9	9	9	9	9
	Total	9	9	9	9	9	9
Mid-Aged Forest							
Very High		0	0	0	0	0	0
High		0	0	0	0	0	0
Moderately High		0	0	0	0	0	0
	Total	0	0	0	0	0	0
Mixed Forest Landscape							
Very High		0	2	0	0	0	0
High		0	3	0	0	0	0
Moderately High		2	11	2	2	2	2
	Total	2	16	2	2	2	2
Grassland							
Very High		32	32	32	32	32	32
High		23	23	23	23	23	23
Moderately High		27	27	27	27	27	27
	Total	82	82	82	82	82	82
Early-Aged Forest							
Very High		0	8	0	0	0	0
High		0	3	0	0	0	0
Moderately High		8	9	8	8	8	8
	Total	8	20	8	8	8	8

HABITAT ELEMENT	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Fire Adapted/Enhanced						
Very High	0	3	0	0	0	0
High	3	4	0	0	0	3
Moderately High	4	5	3	3	3	4
Total	7	12	3	3	3	7
Snags						
Very High	0	0	0	0	0	0
High	1	0	0	0	0	1
Moderately High	0	1	1	1	1	0
Total	1	1	1	1	1	1
Open Midstory and Understory						
Very High	0	7	0	0	0	0
High	7	11	7	7	7	7
Moderately High	11	26	11	11	11	11
Total	18	44	18	18	18	18
Dense High Shrub Understory						
Very High	0	3	0	0	0	0
High	0	2	0	0	0	0
Moderately High	3	3	3	3	3	3
Total	3	8	3	3	3	3
Early-Aged Riparian Forest						
Very High	0	0	0	0	0	0
High	0	1	1	1	1	1
Moderately High	0	0	0	0	0	0
Total	0	1	1	1	1	1
Downed Wood						
Very High	0	0	0	0	0	0
High	4	0	0	0	0	4
Moderately High	6	4	4	4	4	6
Total	10	4	4	4	4	10
Den Trees						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Hard Mast						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	0	0	0	0	0	0
Total	0	0	0	0	0	0
Water (distance sensitive)						
Very High	0	0	0	0	0	0
High	0	0	0	0	0	0
Moderately High	5	5	5	5	5	5
Total	5	5	5	5	5	5

HABITAT ELEMENT		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Lakeshores, Large Reservoirs							
Very High		0	0	0	0	0	0
High		3	3	3	3	3	3
Moderately High		2	2	2	2	2	2
	Total	5	5	5	5	5	5
Pond Shore							
Very High		0	0	0	0	0	0
High		4	4	4	4	4	4
Moderately High		2	2	2	2	2	2
	Total	6	6	6	6	6	6
All Habitat Elements							
Very High		121	143	91	91	91	120
High		133	152	104	104	104	135
Moderately High		311	340	314	314	314	311
	Total	565	635	509	509	509	566

Of key interest are habitats elements that are associated with high risk to species viability and for which management can reduce risk by improving abundance and distribution. Alternatives A, B-1, and E-1 all would reduce habitat elements associated with high-risk habitat/species relationships as a direct result of management (Table 3 - 47). These associations involve mature forests including mesic deciduous forests, riparian and upland oak forests; early-aged forests, grass/forb woodland or wooded grassland, and the structural diversity or canopy gaps found in these forests. All other alternatives are expected to maintain or increase levels of these habitat elements.

With regard to providing optimal protection and management for all habitat occurrences (primarily rare communities or naturally limited communities), Alternatives C, C-1, and D would provide for the greatest number of species with Very High, High, or Moderately High habitat/species relationship risks to viability (Table 3 - 47). This would be accomplished primarily through the combination of protection and restoration of naturally rare or limited habitats such as cliffline, caves, riparian areas, and rare communities. Management direction in all alternatives would specifically protect clifflines and caves. Riparian areas would be protected in Alternatives B-1 and E-1 and to some extent in Alternative A. Rare communities would be specifically protected in Alternatives B-1, C, C-1, D, and E-1. While protection would be provided for all of these habitats in Alternatives B-1 and E-1, management emphasis would not necessarily include restoration or enhancement of habitats. This difference accounts for the lower number of species with Very High, High, or Moderately High habitat/species relationship risks to viability provide for in this management role in Alternative B-1 and E-1.

With regard to improving habitat abundance and distribution through restoration, Alternatives C, C-1, and D would provide for the greatest number of species with Very High, High or Moderately High habitat/species relationship risks to viability (Table 3 - 47). This would be accomplished primarily through the restoration of habitats such as grass/forb woodland and wooded grassland, canopy gaps, open midstory/understory, fire-enhanced systems, and early-aged forest. Except for early-aged forest, these habitats would be limited or not included in the other alternatives. Early-aged forest would be more abundant under Alternatives A and E-1. Older forest conditions should also improve under Alternatives B-1, C, C-1, and D by a change in the cutting cycle of forests. Alternatives A and E-1 would provide the least amount of this habitat.

Alternatives C, C-1, and D should, through management action, maintain sufficient abundance and distribution of habitats associated with Very High, High, or Moderately High habitat/species relationship risks. (Table 3 - 47). On the surface this would seem to contradict what has been said above. However, close examination shows that, in fact, this means ALL species with very High, High, or Moderately High habitat/species relationship risks to viability would be supported through active management or intentional decisions to provide additional habitat where management can provide it, or to protect and enhance those habitats which are naturally limited. None would be addressed simply by trying to maintain the status quo. Active management would be expected to decrease the risk to species viability from habitat/species relationships in at least some cases. On the other hand, Alternatives A, B-1, and E-1 would manage habitats included in Very High, High, or Moderately High risk habitat/species relationship, due in part to, or largely because of, maintenance of the status quo. This management approach would not be expected to decrease the risk to species viability from habitat/species relationships.

The effect of external influences on species with Very High, High, or Moderately High habitat/species relationship risks to viability should be the same in all alternatives (Table 3 - 47) as outside influences would be expected to override management action. The habitat/species relationships most likely to be affected by external forces are associated with mature hemlock-white pine forest, mature yellow pine forest, and higher elevation forest. The hemlock woolly adelgid is expected to reach the DBNF within one or two decades. Current knowledge suggests management can do little to improve a stand of hemlock's likelihood of surviving an infestation. Limited treatments are in trial stages. Based on current knowledge, near complete loss of mature hemlock, the component of importance to most species in this evaluation, is likely over the next 50 years. A recent southern pine beetle epidemic of unprecedented intensity killed at least 70 percent of the yellow pine on the DBNF. What yellow pine did survive is scattered and largely confined to portions of the Forest where most of the associated species are not known to occur. While management efforts would be taken in all alternatives to re-establish yellow pine and yellow pine-oak forest, none of it will be mature in 50 years. Higher elevations (2,300 ft. and above) are limited on the Forest to a small ownership on Pine Mountain. The proclamation boundary includes less than one thousand acres of higher elevation lands, but much of this is in corporate or trust holdings and acquisition is unlikely.

Alternatives C, C-1 and D would not, through management action, decrease abundance and distribution of habitats associated with Very High, High, or Moderately High habitat/species relationship risks. (Table 3 - 47). Close examination shows that, in fact, this means ALL species with Very High, High or Moderately High habitat/species relationship risks to viability would be supported through active management or intentional decisions to provide additional habitat where management can provide it, or to protect and enhance those habitats which are naturally limited. The active management approach would be expected to decrease the risk to species viability from habitat/species relationships in at least some cases. On the other hand, management of some habitats with Very High, High, or Moderately High risk relationships under Alternatives A, B-1 and E-1 would reduce their abundance and/or distribution from current levels. Also, restoration of naturally rare habitat elements may not occur. Examples of these are mature forests including riparian forests in Alternative A, older forests in Alternative E-1, younger age forests in Alternative B-1, the lack of grass/forb woodland and wooded grassland in Alternative A, and the limited amounts of grass/forb woodland and wooded grassland in Alternatives B-1 and E-1. This management approach could not be expected to lessen the risk to species viability from habitat/species relationships.

Table 3 - 47. Number of species/habitat relationships rated as of Very High, High, and Moderately High risk to terrestrial species viability for each category of management effect by alternative.

Management Role		Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Provide Optimal Protection and Management for All Habitat Occurrences							
Very High		0	0	15	15	15	0
High		4	5	45	45	45	5
Moderately High		22	22	78	78	78	22
	Total	26	27	138	138	138	27
Improve Habitat Abundance and Distribution Through Restoration							
Very High		49	17	49	49	49	17
High		42	20	50	50	50	24
Moderately High		73	112	180	180	180	86
	Total	164	149	279	279	279	127
Maintain Habitat Abundance and Distribution							
Very High		8	41	0	0	0	41
High		48	58	3	3	3	69
Moderately High		106	82	32	32	32	146
	Total	162	181	35	35	35	256
Reduce Habitat Abundance and Distribution as Result of External Factors							
Very High		27	27	27	27	27	27
High		6	6	6	6	6	6
Moderately High		24	24	24	24	24	24
	Total	57	57	57	57	57	57
Decline in Habitat Abundance and Distribution as Result of Management							
Very High		37	58	0	0	0	35
High		33	63	0	0	0	31
Moderately High		86	100	0	0	0	33
	Total	156	221	0	0	0	99
Total for All Management Role Categories							
Very High		119	141	89	89	89	119
High		103	121	80	80	80	103
Moderately High		313	341	313	313	313	314
	Total	535	603	482	482	482	536

Planning for, and evaluation of, species viability for the 2004 Forest Plan focused primarily on providing desired abundance and distribution of habitat elements to comply with NFMA regulations. Risks to species viability also can be greatly reduced by implementing other relevant law and policy. The biological assessments and evaluations conducted as part of all national forest management decisions include specific consideration of effects to federally listed threatened and endangered species, those proposed for such listing, and the Regional Forester's Sensitive Species list. These assessments and evaluations identify where additional protective measures are warranted to provide for continued existence of the species on National Forest System land. Projects that may affect federally listed or proposed species must be coordinated with the U.S. Fish and Wildlife Service. Also, these species are often the focus of inventory and monitoring efforts conducted in support of

these requirements. Additional species-based provisions included in all Forest Plan alternatives supplement existing law and policy. All alternatives include general- and species-specific provisions for federally listed species, developed in coordination with the U.S. Fish and Wildlife Service

Even with management activities and direction designed to reduce risk to federally listed species in every alternative, some Very High, High, or Moderately High risk habitat relationships will remain for some listed species. The one relationship in the Very High risk category, the grass/forb wooded grassland/Virginia spiraea relationship is somewhat misleading. The habitat condition in which Virginia spiraea does best is similar to the grass/forb wooded grassland habitat, hence the coding as such in one variable. However, the species is found on rock and cobble bars along rivers and is, in fact, a riverine species. The actual creation of wooded grassland will not affect the management of or viability of Virginia spiraea unless it is created on rock bars. In this sense, Alternatives A, B-1, and E-1 do little for the species by predicted acreage of wooded grassland, but management in the three alternatives does not necessarily rule out treatment of vegetation at Virginia spiraea sites.

Four habitat/species relationships would fall into the High risk category in at least some alternatives. They include: 1) grassland/Virginia big-eared bat, 2) wooded grassland-woodland/Virginia big-eared bat, 3) caves/gray bat, and 4) lake-large reservoir-pond shore/bald eagle. Little or no wooded grassland or woodland would be created in Alternatives A, B-1, and E-1, putting the grassland/Virginia big-eared bat relationship in the High risk category. Virginia big-eared bats have been documented foraging in similar habitat, and it is believed such habitat would benefit them. This, in combination with an F2 status, leads to a habitat/species relationship in the High category. The other three relationships would fall into the High risk categories regardless of alternative. Management cannot be expected to expand naturally occurring landscape features such as caves. Hibernation habitat for gray bats – caves – remains at historical levels and is unlikely to be supplemented by management action. The species is an F1 even with current habitat, so the species/habitat association risk is likely to remain High under any alternative. However, every alternative would offer cliff and cave protection. Regardless of alternative, more bald eagle habitat would exist than at any time before European settlement. Even so, the bald eagle as a breeding species is only an F1 on the DBNF, and the habitat/species relationship risk level involving available pooled water remains High. The grassland/Virginian big-eared bat habitat/species relationship would be at the High level in all alternatives. Grassland is another habitat the species has been observed using for foraging habitat. The species' F2 status, plus low levels of grassland in all alternatives would keep this relationship in the High category.

Moderately High habitat/species risk relationships would occur for five listed species in each of the six alternatives. The natural limitations of caves and or rockshelters and the F2 status of white-haired goldenrod and Virginia big-eared bat put these relationships in this risk category. The natural limitations of mature riparian forest and the F1 status of bald eagle and gray bat put these relationships in this risk category. Additionally, these species have a relationship with general mature forest and forest interior. Since all alternatives would have a Moderately High risk for these relationships, the F1 status of the bald eagle and gray bat, not the amount of mature forest, would drive the risk. The riverbank/Virginia spiraea relationship falls into a Moderately High level. The natural limitations of riverbank habitat and the F1 status of the species lead to this risk level. Virginia spiraea also has a relationship with grass/forb wooded grassland-woodland, as explained above, that ranks in the Very High risk category. Because grass/forb wooded grassland-woodland would be more plentiful under Alternatives C, C-1, and D, the risk level for these alternatives drops to Moderately High. The grass/forb wooded grassland-woodland/Indiana bat relationship is based on

observations and research showing that Indiana bats will forage at forest edge and in open stands – primarily the woodland portion of the habitat element. For this habitat/species relationship, the Moderately High risk category would apply only to Alternatives A, B-1, and E-1. For Regional Forester's sensitive species on the DBNF, Very High, High, and Moderately risk habitat/species relationships would remain under every alternative (Table 3 - 48). The greatest number would occur under Alternative B-1 and the least under Alternatives C, C-1, and D. The Very High risk levels in all alternatives are associated with the dry cedar-oak woodland/Canby's mountain lover, grassland /Fraser's loosestrife, mature yellow pine and mixed pine-oak/sweet pinesap, and the grassland and mature high-elevation mesic hardwood/Agoyan cataract moss relationships. Dry cedar-oak woodland is naturally limited on the landscape to limestone cliff and outcrop areas, although management action can improve the quality of the woodland. Since habitat is limited and Canby's mountain lover is an F1 on the DBNF, this habitat/species relationship risk would remain Very High under all alternatives. Grasslands would be limited under all alternatives, especially so under Alternatives B-1 and E-1. Grasslands are not typical of the vegetation on the Cumberland Plateau, although historically they existed on the landscape. Since the habitat is limited and both Fraser's loosestrife and Agoyan cataract moss are F1 species on the DBNF, these habitat/species relationship risks would remain Very High under all alternatives. The creation of grassy and grassy woodland or wooded grassland would reduce this risk some under Alternatives C, C-1, and D. The DBNF proclamation boundary includes very little high-elevation forest which together with the F1 status of Agoyan cataract moss result in a Very High habitat/species risk relationship under all alternatives. The loss of large acreage of mature forest with a pine component together with the slow nature of replacing this mature component and the F1 status of sweet pinesap would result in a Very High habitat/species risk relationship in all alternatives.

High risk habitat relationships for Regional Forester sensitive species are associated with bogs, springs and seeps; caves; wetlands; dry cedar-oak woodlands; grasslands; xeric-mesic oak forest; mature yellow pine and mixed yellow pine-oak forest; and grass/forb wooded grassland-woodland. Bogs, springs, and seeps; caves, wetlands, and dry cedar-oak woodlands are naturally limited on the landscape. The habitat/species relationship risks associated with these habitats, occurring in all alternatives, affect Closter's brook hypnum, Agoyan cataract moss, white-fringeless orchid, French's shooting star, small spreading pogonia, mountain thaspium, and southeastern bat. All of these species have a rank of either F1 or F2 indicating that inherent rarity of the species also contributes to the risk level. Mature yellow pine and mixed yellow pine-oak forest, while somewhat controlled by management action, is currently limited on the landscape due the southern pine beetle epidemic. The species associated with this habitat, small spreading pogonia, is an F2, indicating a relatively limited population. The High risk relationship would occur in all alternatives. This species is also part of a High risk relationship in all alternatives involving grasslands. Grasslands by management design are limited in all alternatives as they are not typical of the vegetation on the Cumberland Plateau, although historically they existed in small amounts on the landscape. Limited occurrence and the species' F2 rank lead to a relationship risk in the High category. Xeric-mesic oak forest (includes all oak forest from xeric to mesic conditions) and grass/forb wooded grassland-woodland are somewhat controlled by management action. Three species associated with oak forests include southern heartleaf, sweet pinesap, and mountain catchfly. Each has an F1 rank, and with reduced acreage of habitat in Alternative B-1, the combination would lead to a High risk rating. The last species, mountain thaspium, is also associated with the grass/forb wooded grassland/woodland habitat in the High habitat/species relationship category. This High risk would occur only in Alternatives A, B-1, and E-1 where restoration of this habitat does not occur or is limited. Moderate risk habitat

relationships are associated with bogs, springs, and seeps; clifflines; grass/forb woodland and wooded grassland; grassland; mature forest (general); mature/old-aged riparian forest; mixed mesophytic forest; riparian habitat (general); early-aged forest; caves; mature yellow pine and mixed yellow pine-oak forest; mature xeric-mesic oak forest; mixed forest landscape; open midstory; and river channels. Bogs, springs, and seeps; clifflines; mixed mesophytic forest; riparian habitat (general); caves; river channels; and, to some extent, mature old/aged riparian forests are all limited by natural conditions on the landscape. Management is unlikely to create any more of the basic habitats on the ground. Species associated with bogs, springs and seeps (small spreading pogonia); clifflines (three liverworts, Canby's mountain lover, and magnolia vine); mixed mesophytic forest (mountain heartleaf and magnolia vine); riparian habitat (general)(southeastern bat, one liverwort); mature riparian forest (southeastern bat); caves (or rockshelters-cliff caddisfly); and river channels (Rockcastle aster, yellow false foxglove, Closter' water hypnum), are all F1 or F2 species on the DBNF. The combination of species rarity and naturally limited habitat – i.e. it occurs where it was likely to have occurred in the past and additional areas of these habitats are unlikely – leads to Moderately High risk for these habitat/species relationships. Management can to some extent influence the age of riparian forests, but the underlying potential for occurrence of this forest community is still naturally limited. For the species associated with this habitat, southeastern bat, an F1, the habitat/species relationship risk comes as much or more so from the rarity of the species rather than habitat rarity.

Canopy gaps are a natural feature in forest land, but management action can influence the amount and distribution. Grass/forb woodland and wooded grassland, grassland, early-aged forest, mature xeric-mesic oak forest, open midstory, mixed forest landscape, and mature forest (general) are controlled in large part by management action. Grasslands would be limited under all alternatives, especially so under Alternatives B-1 and E-1. Grasslands are not typical of the vegetation on the Cumberland Plateau, although historically they existed in small amounts on the landscape. Since the habitat is limited and the species in this habitat/species relationship risk category, the associated Diana fritillary is an F3 on the DBNF, a Moderately High risk to viability from the habitat/species association can be expected under all alternatives. Grass/forb woodland and wooded grassland would be limited under Alternatives B-1 and E-1 and not managed under Alternative A. Two of the species associated with this habitat – Rafinesque's big-eared bat and Diana fritillary – are F3s on the DBNF. Combined with the rarity of the habitat under these alternatives, a Moderately High level of risk to viability from the habitat/species relationship is likely to occur. The relatively higher levels of this habitat provided under Alternatives C, C-1 and D should maintain the risk below the Moderately High level. Because of their greater rarity, the viability risk their habitat/species relationships for Fraser's loosestrife and Canby's mountain-lover, both F1s, would be Moderately High in Alternatives C, C-1, and D (as opposed to a Very High risk rating in alternatives A, B-1, and E-1; see above). The habitat/species relationships between canopy gaps and associated species, Rockcastle aster, Canby's mountain-lover, and magnolia vine, result in a Moderately High risk to viability in all alternatives. The inherent status of all of the species (all F1) is responsible for most of this relationship risk. The habitat/species relationships between canopy gaps and associated species, southeastern bat and a liverwort, both of which are F1, results in a Moderately High risk relationship, primarily as a result of species rarity. Two habitat species relationships are associated with early-aged forest, one with Diana fritillary, and one with Rockcastle aster. Only in Alternative B-1, in which the least amount of early-aged forest is created, would the relationship climb to the Moderately High level. This habitat/species relationship would not be ranked in the Very High, High, or Moderately High categories under the other alternatives. The Moderately High risk level

occurs for all alternatives for Rockcastle aster. In this case, the aster's rarity (F1) leads to this risk level. The species is actually a rock bar/cobble bar species, but needs an open canopy or canopy gaps within in that habitat. Creation of upland gaps would have no effect on the species, however.

The habitat/species relationships between mature forest (general) and the associated glossy supercoil, sweet pinesap, mountain catchfly, Fraser's loosestrife, and magnolia vine result in Moderately High risk to viability of these species in all alternatives. Even under Alternative B-1, in which little of the DBNF would be managed for a condition other than mature forest, the risk would be Moderately High. The risk level would not decrease under Alternatives A and E-1 in which the amount of mature forest would decrease by between 30,000 and 40,000 acres at any one time over B-1. In both cases, this is because all five species have high levels of rarity on the DBNF (F1 for all). Mature yellow pine and yellow pine-oak forest/Diana fritillary form a relationship with a Moderately High risk rating. The lack of mature yellow on the Forest and the species' F3 status contribute to this risk level. Mature xeric-mesic oak forest forms habitat/species relationships with sweet pinesap, mountain heartleaf, and mountain catchfly resulting in the Moderately High risk level for all alternatives. All three species are F1s and this factor is primarily responsible for the risk rating. For Alternative B-1, mature xeric-mesic oak is in a Moderately High relationship risk level in association with small spreading pogonia and hairy skullcap, both F2s. This risk level occurs in Alternative B-1 because of an increased likelihood of oak forests becoming dominated by non-oak mesic species over time. For Alternative B-1, mixed forest landscape (ages, structure, composition differences) is associated with Rafineque's big-eared bat and Diana fritillary at the Moderately High risk level. Both species are F3, but Alternative B-1 has the least diverse landscape overtime of all the alternatives. This factor contributes primarily to the risk rating.

Alternatives differ in the number of species for which there would be Very High, High or Moderately High risk habitat/species relationships (Table 3 - 48). The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with Very High habitat/species relationship risks are either F1s or F?s that are treated as F1s. These species are very rare on the DBNF, and this contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out would contribute further to the risk. In some cases this is the result of inherently limited habitats such as dry-xeric cedar-oak forest or wetlands. In other cases this is because external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases result from differences in management action levels, e.g., the limited amounts of young-aged forest in Alternative B-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives.

The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with High habitat/species relationship risks are either F1s, F? that are treated as F1s, or F2s. These species are rare to very rare on the DBNF, and their rarity contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out contribute further to the risk. In some cases, this is because of inherently limited habitats such as bogs or seeps, canebrakes, dry-xeric cedar-oak forest or wetlands. In another case, external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases are the result of differences in

management action levels among alternatives, for example, the limited amounts of young-aged riparian forest provided for under Alternatives B-1, C, C-1, D, and E-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives. Habitat/species relationships involving pond margins are in yet another category. Ponds are more numerous and better distributed across the landscape currently than was the case historically. However, the species associated with them are F1s and their rarity triggers the High level of risk associated with these habitat/relationships.

The numerous rare – but not federally listed or on the Regional Forester's sensitive list – species, associated with Moderately High habitat/species relationship risks are either F1s, F? that are treated as F1s, F2s, or F3s. These species are very rare to somewhat rare on the DBNF, and their rarity contributes to the habitat/species relationship risk regardless of habitat conditions. For some habitat species relationships, the low amounts of habitat projected 50 years out contribute further to the risk. In some cases this is the result of inherently limited habitats such as bogs or seeps, caves, cliffline, dry-xeric cedar-oak forest, mixed mesophytic forest, riparian habitat, river channels, or wetlands. In another case this is because external influences are expected to modify and reduce available habitat over the next 50 years, as is the case with mature hemlock-white pine forest and the expected effects of a hemlock woolly adelgid infestation. Some cases are the result of differences in management action levels among alternatives, for example, the limited amounts of young-aged forest provided for in Alternatives B-1, C, C-1, D, and E-1; the small amount of open midstory/understory in Alternative B-1; the absence or limited amounts of grass/forb woodland and wooded grassland in Alternatives A, B-1, and E-1; and the limited amounts of grassland in all alternatives. Management can, to some extent, influence the age of riparian and beech forests, but the underlying potential for occurrence of these forest communities is naturally limited. Habitat/species relationships involving pond margins, mature forests, mature forest interior, and canopy gaps are in yet another category. Ponds are more numerous and better distributed across the landscape currently than was the case historically. However, the species associated with them are F1s. That factor and their rarity trigger the High level of risk associated with these habitat/relationships. Alternatives differ in the amount of mature forest, mature forest interior, and canopy gaps they would provide. The species associated with these habitats are either F1s or F?s that are treated as F1s. Such very rare occurrences override differences in the availability of these habitats. For other habitat elements, a difference among alternatives sometimes reduces the risk of the habitat/species relationship imposed on species viability. For some species, however, their inherent rarity overrides any abundance of habitat. This is the case with downed wood and dense high shrub understory.

Overall, Alternatives C, C-1, and D would provide for more habitat/species relationships with fewer Very High, High or Moderately High risks than the other alternatives. Alternative B-1 would carry with it the most Very High, High or Moderately High habitat/species relationship risks, primarily as the result of limited young-aged forest habitat provided for in the alternative.

Table 3 - 48. Number of terrestrial species with Very High, High, and Moderately High risk habitat relationships within each category of species status by alternative.

SPECIES STATUS	Alt.-A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Federally Listed, or Proposed, as Threatened or Endangered	6	6	5	5	5	6
Regional Forester's Sensitive Species	23	24	22	22	22	23
Other Species of Viability Concern	191	200	182	182	182	191
Total for All Species Status Categories	220	230	209	209	209	220

In conclusion, differences in effects to viability risk between alternatives would be relatively small. Current High risk species/habitat relationships result primarily from historical influences that have reduced distribution and abundance of some habitat elements and species populations. External forest health threats are likely to have the greatest future impacts. In general, the effects of proposed management strategies would be small compared to historical impacts and future external threats. Risks to species viability would be minimized by alternatives that provide a balanced mix of low-disturbance and disturbance-dependent habitat elements. Some elements in this mix would be best provided through passive management and protection. Others may require active management for restoration and maintenance.

Efforts to refine information on current abundance of species on the DBNF will continue, and results of these efforts will be reflected in various documents over the life of the 2004 Forest Plan. The refinement of this input data could change risk ratings for individual species; however, overall patterns of risk relative to habitats and management effects are not expected to change substantially.

AQUATIC SPECIES VIABILITY

Affected Environment

The landscape of eastern Kentucky has changed dramatically since the late 1800s, when the dominant use was small-scale subsistence farming. Logging and land clearing for agriculture accelerated in the early 1900s, and by 1930 most of eastern Kentucky had been cleared. From the 1920s to the 1970s, mining companies stripped and deep-mined coal on adjacent private lands both inside and outside of the proclamation boundary. Mining resulted in the loss of valuable topsoil, high rates of stream sedimentation, and degradation of aquatic habitats and faunal communities. These early impacts to the land that would become the DBNF helped shape the current landscape and conditions of the streams and aquatic systems.

Coal mining has degraded over 40 miles of stream on DBNF system lands. Oil drilling has degraded another 20 miles. Sedimentation and runoff of agricultural chemicals as well as animal wastes from farm lands, discharge from domestic wastewater systems, and sedimentation from roads and timber harvest are also water quality issues facing DBNF managers today.

An increase in the amount of off-highway-vehicle (OHV) and horse riding use, on and off the DBNF, has increased stream sediment loads and adversely affected aquatic biota. The special problems generated by OHVs are addressed in a separate Environmental Impact Statement (USDA Forest Service 1998).

Since implementation of the DBNF's 1985 Plan, Forest managers have improved 2,180 watershed acres, upgrading hydrologic function, soil productivity, and water quality.

For this analysis, short-term refers to activities or conditions that occur within the expected life of the 2004 Forest Plan (10 years). Long-term refers to activities or conditions that occur beyond the expected life of the Plan.

VIABILITY EVALUATION

National forests are required to manage aquatic habitats for the maintenance of viable populations of existing native and desired non-native plants, fish, and wildlife species in the planning area. The National Forest Management Act (NFMA) defines a viable species population as "the estimated numbers and distribution of reproductive individuals to insure its continued existence [and] is well distributed in the planning area so that those individuals can interact" (36 CFR 219.19).

Aquatic habitats are those in and adjacent to streams and lakes. The mobility of aquatic species is usually limited to these habitats. Habitat alteration is likely the major cause of decline of aquatic diversity in the South. Channelization, impoundment, sedimentation, and flow alterations are the most common physical habitat alterations associated with the decline of aquatic species (Walsh et al. 1995; Etnier 1997; Burkhead et al. 1997). Other human-induced impacts to aquatic species include pollution and introduced species (Miller 1989).

Habitat quality within a freshwater ecosystem is determined by activities within the watershed (Abell et al. 2000; Scott and Helfman 2002). Effects of proposed activities on suitable aquatic habitat in a watershed can be estimated from watersheds having similar characteristics. At the Forest Plan level, the watersheds considered for aquatic species are 5th level hydrologic units.

To determine if adequate habitat conditions exist for PETS (Proposed, Endangered, Threatened and Sensitive) species, 5th level watershed condition was assessed including both impacts occurring on private as well as on public lands. Watersheds assessed were those with any National Forest ownership. Watershed condition was determined from the physical and anthropogenic interactions within the watershed. The extent and detail required to address all watersheds, including private land, made it necessary to determine values from geographic data. After these values were compared among the watersheds, a condition or set of conditions was determined.

METHODS AND ASSUMPTIONS FOR WATERSHED CONDITION

Watersheds or hydrologic units are defined as areas that drain to a common point. Fifth level watersheds are generally between 40,000 and 250,000 acres. Geographic information (GIS) layers were queried by watershed. These layers include ownership, streams, roads, point sources, dams, and land-use from the 1970s and 1990s.

These layers were intersected with the 5th level watersheds and determined as a percent of the watershed or as a density (miles per square mile). Table 3 - 49 identifies the layers, their use, data source, and unit of measure.

Table 3 - 49. Geographic layers used to determine watershed condition.

Layers	Use	Source	Unit
Watersheds	Planning unit	NRCS or USFS	5th level HU
Ownership	To determine the potential of affect of NF ownership on viability of Species of Concern	Individual Forests	Percent
Streams	Used to determine riparian areas	RF3 data from EPA Basins III	Not applicable
Roads	Road density and riparian road density	TIGER census data	Miles per square mile
Landuse	Determine watershed and riparian area landuse	1970 GIRAS data from EPA Basins III, 1994 NLCD from EPA Region 4	Percent
Dams	Determine altered flow	EPA Basins III	Number per square mile
Point sources	CERLIS, RICRIS and NPDES	EPA Basins III	Number per square mile

This process is modified from the East-wide Assessment Protocol for Forest Plan Amendment, Revision, and Implementation (USDA Forest Service 2000). Instead of a simplified ranking, the individual condition factors were valued or graded (one to five) based on natural breaks using the Jenk's optimization formula within ArcView 3.2a. The values for each layer were averaged to calculate a condition score for each metric where; 1 – 1.5 = Poor, 1.51 – 2.5 = below average, 2.51 – 3.50 = Average, 3.51 – 4.5 = Above Average, 4.51 – 5 = Excellent. This allows for a determination of condition among the watersheds. However, it does not suggest that the condition of a watershed with a score of 4 is twice as good as a watershed of 2, only that the condition of a watershed with a value of 4 is above average and the watershed with a value of 2 is below average. These metrics were developed to determine watershed condition for individual issues or concerns.

A species-sediment load relationship index (SSI) was developed to characterize the condition (Excellent, Average, and Below Average) of 5th level watersheds with respect to current sediment load increases and to determine a range of potential effects. These metrics were used to determine watershed condition for particular stressors listed below:

1) Sedimentation, assessed separately by determining the percent increase above the baseline sediment levels by watershed as assessed with the Watershed Condition Rank (WCR)
2) Point Source Pollutants (density of point sources)
3) Temperature (road density in the riparian area, and percent forest in the riparian area) (1970s and 1990s data)
4) Altered stream flow (density of dams, road density in the riparian area and average density of strip-mines).

Stressors

PETS species were noted for each 5th level watershed in which they occurred across the Forest. The PETS species referenced are those identified by the US Fish and Wildlife Service as potentially occurring on or adjacent to the Daniel Boone National Forest. Watershed condition was assessed with the occurrence of aquatic PETS species and their associated stressors within this 5th level. This 5th level watershed analysis is to examine the coarse filter of watershed condition from impacts on private and public lands. This coarse filter at the 5th level will allow the Forest Service to examine conditions throughout the entire watershed in order to understand the status of aquatic PETS species.

Four stressors were identified: sedimentation, point-source pollution, alterations in water temperature, and altered stream flows. Sensitivity to these stressors was assigned for each species, based on the published literature and personal communications (Terwilliger 1991; Etnier and Starnes 1993; Byron Freeman, Wendell Haag, Melvin Warren, Bernard Kuhajda, Stephen Hiner, and Arnold Eversole, personal communication). Species sensitivity to the four stressors was compared with the condition of their respective watersheds to determine the threats to their persistence in the planning area. Threats to aquatic species viability are not limited to these four variables. The variables chosen were selected based on the consistency of Geographic Interface System information across both private and public lands, but do not reflect all impacts to the viability of aquatic biota. In addition, the thresholds of PETS species to these four stressors are not known. Loss of viability would result in extirpation or possibly extinction. There have been no known extirpations of any PETS aquatic species from the DBNF.

Forest level planning assumes that these four stressors describe any potential land disturbance activities within the planning area. The Forest Service seeks to maintain or enhance waters within public ownership. Habitat on National Forest System lands will be maintained or enhanced. These waters also could provide refuge for some imperiled species.

Combination of Watershed Condition and Stressors

To identify watersheds at risk, the combined values for each watershed condition value or parameter (sediment, point sources, temperature and altered flows) were multiplied against the presence (value of 1) of species of concern with corresponding stressors. Watershed condition metrics with a score $\geq$ 2.51 (average or above for point sources, temperature and altered flows) and an SSI of Excellent (for

sediment) are assumed to have sufficient aquatic habitat at the watershed scale to maintain species viability.

Aquatic Viability Outcomes

Species of concern were related to the four environmental factors assessed in the watershed analysis (point sources, water temperature, flow, and sediment). Separate viability outcomes were determined for each watershed where a species occurs because factors affecting viability can vary considerably from one watershed to another. Viability outcomes for each species by watershed were determined by incorporating elements of species distribution, abundance, and sensitivities to environmental factors; watershed condition relative to the species' environmental sensitivities; and the amount of National Forest ownership in the watershed. Viability outcomes are as follows:

> **Outcome A:** Species occurs within watersheds with no impairment. Likelihood of maintaining viability is High.
>
> **Outcome B:** Species is potentially at risk in the watershed; however, Forest Service action may influence habitat conditions on public lands that will keep it well distributed where its associated habitat occurs on National Forest System lands. Therefore, likelihood of maintaining viability is Moderate.
>
> **Outcome C:** Species is potentially at risk within the watershed; however, opportunities for the Forest Service to affect outcomes for the species in the watershed are limited. PETS species within this outcome are off National Forest System lands. Therefore, species viability in the watershed may be at risk.
>
> **Outcome D:** The species is so rare within the watershed (population is at Very Low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service actions could influence conditions in the watershed to keep the species relatively secure. Therefore, likelihood of maintaining viability is Moderate to Low.
>
> **Outcome E:** The species is so rare within the watershed (population is at Very Low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service ability to influence the species is limited. Therefore, species viability in the watershed may be at risk.

For a summary of aquatic PETS species on the DBNF by number of watersheds and viability outcome, see Table 3 - 50. No outcomes should change as a result of impacts from any of the alternatives. The "Total Watersheds" column lists the number of watersheds in which each PETS species occurs. The species listed in the following table are those that were identified by the US Fish and Wildlife Service as potentially occurring on or adjacent to the Daniel Boone National Forest.

Table 3 - 50. Summary of PETS and non-PETS by number of watersheds and viability.

Species	Number of watersheds by Viability Outcome					Total
	A	B	C	D	E	Watersheds
American Brook lamprey	3		1			4
Ashy darter	4		4			8
Big South Fork crayfish	1		1			2
Blackside Dace	8		2			10
Blotchside logperch			1			1
Cumberland Bean	4		5			9
Cumberland elktoe	3					3
Cumberland Johnny darter	7		2			9
Cumberland papershell	1					1
Cumberlandian Combshell	3		1			4
Duskytail Darter	1		1			2
Eastern sand darter	6		3			9
Fanshell						
Fluted Kidneyshell	4		2			6
Little Spectaclecase	5		4			9
Littlewing Pearlymussel	2		4			6
Longhead darter	1		1			2
Long-solid	2					2
Mountain Brook lamprey	1		1			2
Northern madtom	1		1			2
Olive darter	3		1			4
Oyster Mussel	3		1			4
Palezone Shiner			2			2
Pink mucket						
Purple lilliput	2		2			4
Pyramid pigtoe	1					1
Rabbitsfoot						
Salamander mussel	1		1			2
Sheepnose	1					1
Snuffbox	3		4			7
Southern cavefish	1					1
Spectaclecase						
Spotted darter			1			1
Tan Riffleshell	1					1
Tennessee clubshell	3		4			7
Tippecanoe darter	1		2			3
Western sand darter						
Non PETS Species	4		1			5

PETS species with an Outcome of A are considered at low or no risk to their viability. Species with an Outcome of C are subject to impacts from one or more of the stressors. These species are off National Forest System lands, and the Forest Service may not be able to do anything to measurably improve their habitat conditions. Due to the coarseness of the model no species have viability Outcomes in B, D, or E.

Any degradation of aquatic habitat can adversely affect aquatic management indicator species (MIS). The effects on species more tolerant to sediment and other forms of pollution would be similar for all alternatives. The differences will be more apparent in species that are sensitive to pollution or have very low populations. The next section describes the MIS and how each alternative would affect them.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

None other than those listed under the alternatives.

CUMULATIVE EFFECTS

Best Management Practices (BMPs), the Riparian Corridor Prescription Area, and Forest Plan Standards should minimize direct and indirect adverse effects to aquatic communities. Adverse effects, however, will not be eliminated from the entire watershed. Cumulatively, Forest Service activities may contribute to sediment in the watershed.

Watershed Condition Rank (WCR) is a measure that characterizes the condition of 5th level watersheds with respect to current and future sediment load increases. In order to establish WCRs, the current sediment average annual yield is determined and expressed as a percent above the baseline conditions. This provides a relative measure to determine changes within watersheds. The next step in this process is determined by using the relative abundance of locally adapted species with respect to predicted sediment increases to create a species-sediment load relationship or index (SSI). This score is modified by a weighted average where the watershed occurs in more than one physiographic zone. Watershed condition is generalized into three categories of Excellent, Average and Below Average. The SSI, however, does not necessarily translate into an excellent or poor watershed but broadly categorizes the watersheds based on the sediment prediction/aquatic viability relationship. The SSI is a relatively large-scale coarse filter developed to evaluate alternatives in Forest Plans and to establish priority work at the planning scale. Therefore, further detailed analyses of the watershed will be conducted at the project level.

Table 3 - 51 summarizes the cumulative watershed condition for all alternatives within period one (the first decade). A brief description of the process and the current conditions are described in the Soil and Water section of this document. A full description of the process can be found in the process record for this Final Environmental Impact Statement.

Ownership is the percentage of the watershed managed by the Forest Service. SSI is the species-sediment load relationship or index score. Risk 1 indicates watershed concerns but management actions may influence conditions to improve the condition of the watershed that may reduce the risk to aquatic species. Risk 2 also indicates watershed concerns; however, Forest Service opportunities to measurably affect the watershed are limited. Sources of impairment: S = sediment; P = point-source pollution; T = temperature; F = Altered Flow.

Table 3 - 51. Summary of 1st decade cumulative effects on watershed conditions by alternative.

	Ownership	Current	Watershed Condition			Alt-A	Alt-B1	Alt-C	Alt-C1	Alt-D	Alt-E1
Watershed	%	SSI	Low Risk	Risk 1	Risk 2	SSI	SSI	SSI	SSI	SSI	SSI
5100101040	57.3	E	X			E	E	E	E	E	E
5100101090	11.3	E			S	E	E	E	E	E	E
5100101100	31.8	E	X			E	E	E	E	E	E
5100101110	37.4	E	X			E	E	E	E	E	E
5100101130	29.8	E	X			E	E	E	E	E	E
5100101140	28.4	E	X			E	E	E	E	E	E
5100202010	8.4	E			S	E	E	E	E	E	E
5100202020	0.2	E			S	E	E	E	E	E	E
5100202030	18.5	E	X			E	E	E	E	E	E
5100203010	60.8	E	X			E	E	E	E	E	E
5100203020	17.4	E			S	E	E	E	E	E	E
5100203040	14.2	E			S	E	E	E	E	E	E
5100203050	8.4	E			S	E	E	E	E	E	E
5100204010	2.9	E			S	E	E	E	E	E	E
5100204020	8.7	E			S	E	E	E	E	E	E
5100204030	9.7	E			S	E	E	E	E	E	E
5100204040	9.0				S	E	E	E	E	E	E
5100204050	27.0	E	X			E	E	E	E	E	E
5100204060	11.3	E			ST	E	E	E	E	E	E
5100204070	2.4	E			ST	E	E	E	E	E	E
5100204120	50.2	E	X			E	E	E	E	E	E
5100204140	20.5	E	X			E	E	E	E	E	E
5100204170	8.5	E			ST	E	E	E	E	E	E
5130101350	4.7	E			S	E	E	E	E	E	E
5130101360	17.1	E			S	E	E	E	E	E	E
5130101370	57.6	E	X			E	E	E	E	E	E
5130101400	19.5	E	X			E	E	E	E	E	E
5130101410	29.7	E	X			E	E	E	E	E	E
5130101420	62.3	E	X			E	E	E	E	E	E
5130101440	54.3	E			S	E	E	E	E	E	E
5130101450	38.9	A			S	A	A	A	A	A	A
5130102030	44.5	E	X			E	E	E	E	E	E
5130102040	10.2	E			S	E	E	E	E	E	E
5130102050	38.7	E	X			E	E	E	E	E	E
5130102060	6.8	A			S	A	A	A	A	A	A
5130102070	46.7	E	X			E	E	E	E	E	E
5130102080	3.9	E			S	E	E	E	E	E	E
5130102090	34.5	A			S	A	A	A	A	A	A
5130102100	89.6	E	X			E	E	E	E	E	E
5130103010	60.7	E	X			E	E	E	E	E	E
5130103020	95.1	E	X			E	E	E	E	E	E
5130103040	9.6	E			S	E	E	E	E	E	E
5130104250	43.3	E	X			E	E	E	E	E	E
5130104270	5.5	E			S	E	E	E	E	E	E
5130104290	60.6	E	X			E	E	E	E	E	E
5130104310	5.1	E			S	E	E	E	E	E	E

The Watershed Condition rating from Table 3 - 51 indicates which source of impairment (S, P, T or F), if any, is a major stressor in that watershed, and whether or not the Forest Service can measurably influence that impairment at the watershed level. Where the impairment is sediment (S), Forest Service influence is limited based on the SSI discussion below. Where the impairment is temperature (T), the Forest Service can influence conditions at a local level by maintaining a streamside canopy. However, streamside canopy often is not sufficient to mitigate temperature increases originative from private land; therefore, the Forest Service's influence on temperature at the watershed level is limited.

The SSI is used to characterize cumulative effects of sediment from both private and National Forest System lands within a specified watershed. It takes into account biological thresholds for sediment. Possible SSI are: Excellent (E); Average (A); Below Average (BA); a Below Average SSI rating indicates that the effects from sediment are approaching a biological threshold. No DBNF watersheds merited a Below Average rating.

WCR calculations are useful in the development of forest plan objectives. The following section details WCR outcomes with respect to adverse effects on aquatic biota as they are related to forest management:

> A watershed SSI of Excellent indicates a Low probability for adverse effect to aquatic species. If the results of a forest plan alternative remain within this range there should be no adverse effect on water quality with respect to beneficial uses (fish communities). Forest plan objectives, therefore, would focus on maintaining or improving aquatic health through the implementation of management prescriptions that support riparian values.
>
> A watershed SSI of Average**,** indicates a Moderate probability for adverse effects on beneficial uses. In this case, forest plan objectives should stipulate that watershed assessments be conducted during project planning to identify pollution sources. Additionally, objectives should provide for monitoring prior to project implementation to determine actual health of the biota.
>
> A watershed SSI of Below Average, indicates a High potential for adverse effects to beneficial uses. In addition to the objectives listed above, forest management at the project level should seek to maintain or restore watershed health and aquatic systems where Forest Service actions can make meaningful contributions to watershed health. Forest plan prescriptions should be applied in an effort to correct unhealthy situations.

The sediment model and the WCR both rely on numerous assumptions. To minimize any misunderstanding, every effort has been made to acknowledge assumptions and describe them clearly. In light of these assumptions, however, neither the sediment model nor associated WCR should be regarded as absolutes. At the forest plan level, they are useful in comparing the outcomes that would likely result from the various alternatives. Regardless of assumptions or methods, the overall intention remains the reduction of risk to water quality and aquatic biota.

Watershed condition, expressed at the outfall of the watershed, reflects accumulation from disturbances across the entire watershed. Subwatersheds within a 5th level watershed will have a range of conditions. The conditions of subwatersheds and the determination of effects will occur at the project level.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under Alternative A, the 1985 Plan and would continue to be implemented while meeting or exceeding minimum protection under the Endangered Species Act and the National Forest Management Act. The harvest/removal of resource products and some recreational activities as well as roads may increase sedimentation with short-term localized adverse affects on aquatic ecological processes. This analysis takes into account that approximately 85 percent of the DBNF is available for leasing of federal minerals. Sedimentation and habitat fragmentation are the main contributors to the degradation of aquatic communities. The impacts from sedimentation would be localized to areas immediately adjacent and downstream from the disturbance site. These short-term effects, however, can lead to long-term adverse effects on aquatic species, e.g., sedimentation deposits on a mussel bed.

Forestwide protective measures under this alternative have been applied to perennial and intermittent streams. Such measures include watercourse protection strips, filter strips, and shade strips. However, there is a concern that the application of these measures may not provide adequate protection to maintain viability of several aquatic species (USDA Forest Service 2001). This will have both long- and short-term adverse effects. Without specific management to support the health and viability of aquatic organisms, those in decline may continue in that direction and those with static populations may remain so or could begin to decline. Fragmentation, habitat, and ownership, would continue to be a problem and habitat fragmentation could increase with time. Fragmentation would have long- and short-term detrimental effects on the aquatic community if populations are isolated or movement is restricted. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. The continued introduction of this non-native species, in addition to the public's impact in the pursuit of this species, will have long- and short-term adverse effects. Due to the predatory nature of this species, short-term stocking of trout may affect the long-term productivity of stocked streams by reducing genetic diversity and the number of aquatic organisms available to repopulate the stream if trout are removed. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Under the National Forest Management Act (NFMA), the Forest Service is charged with preserving and enhancing the diversity of plants and animals consistent with overall multiple-use objectives stated in the Forest Plan [16 U.S.C. 1604(g)(3)(B) – Planning Management Requirements]. To do this, MIS are selected "because their population changes are believed to indicate the effects of management activities" [36 CFR 291.19(a)(1), Planning – Fish and Wildlife Resources].

In general MIS are selected to meet one of the following criteria. They can be:

- Ecological indicators
- Species commonly hunted or of economic significance
- Threatened or endangered species.

Table 3 - 52 shows the seven fish species selected to track a variety of aquatic habitats and conditions.

Table 3 - 52. MIS and habitat and conditions being tracked.

MIS	Habitat or condition being tracked
Blackside dace	Federal threatened species; found only in a few streams.
Smallmouth bass	Demand species; clean-bottom streams and stream fed lakes.
Arrow darter	Indigenous to upper Cumberland and Kentucky River system.
Fantail darter	Prefers shallow rifles and pools with a gravelly substrate.
Rainbow darter	Occur in streams with clean gravel substrate.
Brindled madtom	Occur in creeks and rivers with very little silt.
Stoneroller	Common and widespread throughout the Forest.

These seven fish were originally selected as MIS for the 1985 Plan. The 5th Year Review Daniel Boone National Forest Lands and Resources Management Plan (USDA Forest Service 1991) and in the Daniel Boone National Forest MIS Population and Habitat Trends Report 1985 – 2000 (USDA Forest Service 2000) determined that none of the seven fish served their intended purpose as MIS. Replacement of the fish species with aquatic macro-invertebrates was recommended. Since Alternative A is the 1985 Plan, these seven fish species would represent MIS for this alternative.

Without the designation of an area specific for the health and viability of aquatic organisms, species susceptible to silt and fragmentation (arrow, fantail, and rainbow darter, and brindled madtom) or with low population numbers (blackside dace) may have stable or falling populations. Species that are less susceptible (smallmouth bass and stoneroller) would have stable populations. And there would be little opportunity for recovery of susceptible species or those with reduced populations.

To help facilitate a comparison of the alternatives, MIS developed for Alternatives B-1 through E-1 were considered for Alternative A. Indices based on aquatic macro-invertebrate assemblages that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, are to be used. Because these indices are not individual, or groups of, species, they will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS for aquatics.

Without the designation of an area specific to protect the health and viability of aquatic organisms, i.e., the Riparian Corridor Prescription Area, species susceptible to silt and fragmentation or with low population numbers may have stable or falling populations. Those species that are less susceptible would have stable populations. There would be little opportunity for recovery of susceptible species or those with reduced populations.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This would contribute little or no sediment to the aquatic system. There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Other wildland fires would be suppressed. In the short-term these wildland fires could cause an increase in sediment loads to adjacent streams.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the DBNF.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

While this alternative would be mainly custodial, it would establish a Riparian Corridor Prescription Area (RCPA). The RCPA would encompass riparian areas, as well as adjacent associated upland components. The width of the RCPA would vary but would always be measured from the edge of the channel or bank. The RCPA encompasses, at a minimum, the 100-year flood plain along perennial and intermittent streams or other water bodies. However, the width could be greater (Table 3 - 53). The width for perennial streams and other perennial water bodies would be a minimum of 100 feet from the bank or channel; and for intermittent streams, a minimum of 50 feet from the channel.

Table 3 - 53. Width of riparian corridor, measured from the edge of each bank.

TYPE OF WATER BODY	Distance from each bank, in feet (if greater than the 100-year flood plain)
Perennial streams and other perennial water bodies (excluding the Large Reservoir PA)	100
Intermittent streams	50

An interrupted stream (a watercourse that goes underground and then reappears) would be measured as if the stream were above ground. For braided streams, the outermost braid would be used as the water's edge. For ponds, small lakes, wetlands (including associated seeps or springs), and other water bodies, the measurement would begin at the ordinary high water mark.

This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. No active manipulation within the RCPA would take place except for visitor safety and to meet the Forest's legal responsibilities such as providing for the viability of plant and animal species and the protection of PETS species. Without active manipulation for the purpose of attaining and sustaining a high diversity of habitat and species, recovery of declining species could be slow or nonexistent.

The viability of aquatic species would, in part, be tracked through the monitoring of Management Indicator Species (MIS). Indices based on aquatic macro-invertebrate assemblages that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. Because these indices are not individual, or groups of, species, they will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. With the custodial emphasis of this alternative, any improvements or recoveries would be slow with most species populations remaining constant. There would be little expected change in the indices due to the lack of management directed to ecosystem improvements.

There would be continued use of the Forest at the maintenance level. New trails would be built and some existing trails would be closed with a resulting net decrease of 52 miles of trails. All trails would be closed to off-highway vehicles. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. Mineral extraction or development

would be limited, especially surface-disturbing activities. Soil baring disturbances and erosion would be minimal.

Timber harvest would occur minimally and recreation facilities and developed sites would only be maintained. This reduction in sediment producing activities would have short- and long-term beneficial effects on the aquatic community. Trout stocking would not be undertaken in this alternative, which would result in short and long-term beneficial effects on the aquatic community. Ownership fragmentation would decrease because of increased emphasis on the purchasing program. Inholdings and other land within the proclamation boundary would continue to be purchased. Riparian management would be minimal except for the viability needs of certain land species. Any short-term sedimentation could lead to long-term adverse effects on aquatic species, e.g., sedimentation deposits on a mussel bed.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This would contribute little or no sediment to the aquatic system. There should be long-term benefits, however, through creation of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the aquatic community.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the Forest.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function while providing for multiple public benefits. It would establish a Riparian Corridor Prescription Area[8] (RCPA). The RCPA would help protect aquatic habitat and reduce habitat fragmentation. The purchasing program of the Forest would decrease ownership fragmentation. Inholdings and other lands within the proclamation boundary would continue to be purchased.

Vegetation management designed to meet viability needs could result in sedimentation from soil disturbance. In the short-term this could create localized adverse impact from increased sedimentation loads to the streams. In the long-term, however, this vegetation management would benefit aquatic habitats through bank stabilization, increased habitat diversity, and the influx of coarse woody debris. Although private mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. Recreation (developed and dispersed) would remain near current levels. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or

[8] See description in Alternative B-1

closed. Aquatic systems and organisms should benefit from this alternative's emphasis on attaining and sustaining a high diversity of habitats and species. Any short-term sedimentation, however, could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of habitats and species. The RCPA would be protected from damaging activities and degraded areas would be restored. In the short- and long-term this would provide habitat to help restore of aquatic PETS species and would be very beneficial to the aquatic community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. This would have long- and short-term adverse effects through the continued stocking of this non-native species and through the public's impacts in their pursuit of this species. No new streams would be considered for stocking. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. Therefore, these indices will be used in lieu of MIS.

There would be a positive effect on MIS from establishment of the RCPA. The emphasis on maintenance of ecological processes should be reflected in increased water quality and aquatic habitat.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system. There should be long-term benefits from the creation of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term, wildland fires can cause increased sediment loads in adjacent streams.

The short-term establishment of a RCPA would have the long-term, productive effect of providing protected habitat for the aquatic community.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution originate primarily off National Forest System lands and would remain beyond the control of the Forest. Sites located on the Forest would be addressed to reduce or eliminate their impacts.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function while providing for multiple public benefits with added emphasis on recreation. It would establish a Riparian Corridor Prescription Area[9] (RCPA). The RCPA should provide long- and short-term benefits by reducing habitat fragmentation and protecting streamside areas. The purchasing program of the Forest should decrease ownership fragmentation. Inholdings and other land within the proclamation boundary would continue to be purchased.

Manipulation of vegetation to improve species viability, in areas adjacent to aquatic habitats, could result in sedimentation from surface and soil disturbance (e.g., prescribed fire, creation of snags, planting, control of non-native invasive species, etc.). In the short-term this may create localized adverse impacts by increasing sedimentation loads in streams. In the long-term, however, such vegetation management would benefit aquatic habitats by stabilizing banks and increasing both habitat diversity and the influx of coarse woody debris. Although mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. The added emphasis on recreation could increase localized sedimentation. An additional 73 miles of trails would be added to the trail system. Trails, roads, and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. The emphasis on attaining and sustaining a high diversity of habitats and species should benefit aquatic systems and organisms. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

The viability of aquatic species would, in part, be tracked through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as 'management indicator species'. They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. Indices would reflect an increase in water quality and aquatic habitat due to the emphasis on maintenance of ecological processes. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the potential increase in recreation use of both developed and dispersed sites.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system.

[9] See description in Alternative B-1.

There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative. Those sites located on the Forest would be addressed to reduce or eliminate their impacts.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize recreational opportunities to the extent possible. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA). See description in Alternative B-1. This would have long- and short-term beneficial effects through reducing habitat fragmentation and protection streamside areas. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased.

Increased recreation for this alternative would result in an increase in localized sedimentation being generated through the increase in roads, trails and facilities. There would be 113 miles of trails added to the current trail system. With this increase in sedimentation there would be short-term localized adverse effects to aquatic resources. These short-term effects, however, could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed. Although mineral development would be allowed in the RCPA, development of federally owned minerals would be more restricted here than in the rest of the watershed. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. Also, other streams would be evaluated for additional trout stocking. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

The viability of aquatic species would, in part, be tracked through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as 'management indicator species.' They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the emphasis on recreation, which may amplify localized sedimentation from the increase in developed and dispersed sites.

Ecosystem diversity and sustainability would be, at least, maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. This would be beneficial, but additional efforts to attain and sustain a high diversity of habitat and species would be secondary to recreational needs and funds. Due to the priority of recreation, there would be less funding available for the development of habitat diversity. There would be more recreational development within the RCPA and this could adversely affect the aquatic community.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. This will contribute little or no sediment to the aquatic system. There should be long-term benefits through the establishment of a more diverse and stable streamside habitat. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Alternative E-1 would emphasize the quality as well as the quantity of resource products to maximize benefits to local and regional communities. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA). See description in Alternative B-1. This would have long- and short-term beneficial effects through reducing habitat fragmentation and protection streamside areas. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased.

The emphasis on commodities development could increase sedimentation levels in areas adjacent to activities with both long- and short-term localized adverse affects on the aquatic community. Trout stocking would be maintained at current levels as long as viability of native species were unaffected. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

The viability of aquatic species would be tracked, in part, through the monitoring of management indicator species (MIS). Indices based on aquatic macro-invertebrate assemblages, that reflect the community structure and function, combined with physical and chemical parameters of the aquatic

system, will be used. These indices are not individual, or groups of, species, and therefore will not be referred to as "management indicator species." They fulfill all the criteria/definitions of MIS but are more effective than any individual or small group in reflecting the health of an aquatic system. The indices will therefore be used in lieu of MIS for aquatics.

There would be a positive effect on MIS due to the establishment of the RCPA. There may be localized detrimental impacts to some assemblages that would be reflected in the indices. This would be due to the emphasis on resource products, which may amplify localized sedimentation from the increase in disturbed sites.

Ecosystem diversity and sustainability would be maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. This would be beneficial, but only at minimal levels. Additional efforts to attain and sustain a high diversity of habitat and species would be secondary to resource products needs and funds. All wildland fires would be suppressed. Fire management would be used to improve plant and wildlife habitat, reduce fuels for fire prevention, and prepare sites for planting or natural regeneration. These fires would have a short-term adverse effect through an increase in the sediment loads of nearby waterways. There would be a long-term beneficial effect through the enhancement and maintenance of biological diversity.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities but would primarily be used to reduce fuels for fire prevention, and prepare sites for planting or natural regeneration. This will contribute little or no sediment to the aquatic system. There would be long-term benefits through the establishment of a more diverse and stable streamside habitat. All wildland fires would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

Any short-term sedimentation could lead to long-term adverse effects on some aquatic species, e.g., sedimentation deposits on a mussel bed.

CUMULATIVE EFFECTS

Impacts from temperature, altered flow, and point source pollution are primarily from non-National Forest System lands and would remain out of the control of the Forest under this alternative. Those sites located on the Forest would be addressed to reduce or eliminate their impacts.

RIPARIAN SPECIES VIABILITY

Affected Environment

Riparian areas are functionally defined as areas with three-dimensional ecotones of interaction that include both terrestrial and aquatic ecosystems. They extend down into the groundwater, up above the canopy, outward across the flood plain, up the near-slopes that drain into the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width (Ilhardt, et al. 2000).

Six distinct habitat types are included in the riparian area. All occur in conjunction with stream corridors. The habitats are related by proximity to a stream, and the function of ground and surface water within the habitats. Three of these habitat types are found within the stream channel itself: sand/gravel/cobble bars, boulder (scour) bars, and stream banks. The other three are found on a stream flood plain or terrace; these are eastern riverfront forest, river flood plain forest and canebrakes.

To date, there has been no systematic survey of the extent or condition of the riparian area on the DBNF. However, cooperative rare species inventories conducted between 1987 and 1993 (USDA Forest Service et al. 1988-1994) identified many locations for sand/gravel/cobble bars and boulder bars, and a few locations for river flood plain forest. Project species surveys have identified others. About 25 locations for bars with rare plants on them are known, all from the Cumberland River drainage. Another two sites are known for river flood plain forest with unusual vegetation, both from the Cumberland River drainage. Several canebrakes are recorded from the northern end of the Forest, but others exist. Eastern river front forest is present on, and dispersed across, the DBNF. Stream bank habitat is present across the Forest. The extent of all of these habitats is unknown.

Current stream miles are likely unchanged from the miles present 200-300 years ago. The condition of the streams and associated habitats probably has changed. Land clearing over the last 200 years removed forest and canebrake vegetation from along larger streams to open land for cultivation. Some of this historic forest has grown back, but little of the cane has. Sand/gravel/cobble and boulder bars are in part a function of erosional processes. Changes in vegetation along streams directly or indirectly would have altered some of the bars, possibly removing some and creating others. Stream bank conditions have changed over the last 200-300 years as a result of natural processes and cultural influences such as clearing, farming, and the building of roads. Today there are fewer miles of wooded stream bank than were present 200-300 years ago, but more exist now on the DBNF than during the early 1900s. Between about 1900 and 1930, most of the land now comprising the DBNF was cut over and burned. This undoubtedly had an effect on these habitats.

The area considered for this analysis is the land within the proclamation boundary of the DBNF.

Environmental Effects

EFFECTS COMMON TO ALL ALTERNATIVES

The management goal for the riparian area is to maintain the structural and functional integrity of riparian habitat and associated aquatic and terrestrial habitats. For this analysis, short-term refers to activities or conditions that occur within the expected life of this Plan. Long-term refers to activities or conditions that occur beyond the expected life of this Plan.

DIRECT AND INDIRECT EFFECTS

There are no direct and indirect effects that are common to all alternatives.

CUMULATIVE EFFECTS

While much of the land within the proclamation boundary of the DBNF is still wooded, including riparian areas, the National Forest System land is more likely to maintain intact riparian habitats than other lands. The need for flat land in the business and private sectors encourages the clearing and draining of flood plain and terrace lands.

Land ownership within the DBNF proclamation boundary is highly interspersed between private, state and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur on non-National Forest System lands within the proclamation boundary is not likely to be different. Private land uses such as development, farming, logging or mineral development are likely to occur at a time, place and rate independent of the alternatives.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Alternative A in the 1985 Plan and would be implemented while meeting or exceeding minimum protection under the Endangered Species Act and the National Forest Management Act. In this alternative, no Riparian Corridor Prescription Area (RCPA) would be established however a riparian protection area is present. This designation would provide protection of the area but would not promote activities to improve the habitat. This will have both long-term and short-term adverse effects. Without the management specific for the health and viability of organisms that need the corridor habitat, those in decline may continue in that direction and those with static populations may remain so or may begin to decline.

Without the protection provided by a RCPA, habitat fragmentation would continue to be a problem and may increase with time. This fragmentation would have long- and short-term detrimental effects on riparian communities by isolating populations and restricting movement. Ownership fragmentation would decrease because of the purchasing program of the Forest. Inholdings and other land within the Proclamation Boundary would continue to be purchased. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Roads, the harvest/removal of resource products, and some recreational activities may have short-term localized adverse affects on riparian ecological processes. Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Long-term benefits should result from establishment of a more diverse and stable streamside habitat.

Wildland fire use fire would be an acceptable management tool. Wildland fires would be suppressed. In the short-term these wildland fires may cause an increase in sediment loads to adjacent streams.

CUMULATIVE EFFECTS

There would be no additional cumulative effects beyond those previously described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

With an emphasis on custodial elements, it does provide for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This will provide for some protection of the riparian habitat and will help reduce habitat fragmentation. Ownership fragmentation would decrease because of the purchasing program of the Forest. In-holdings and other land within the Proclamation Boundary would continue to be purchased.

There will be no active vegetation manipulation within the RCPA except for visitor safety and to meet minimum legal requirements such as providing for the viability of plant and animal species and protection of PETS Species. Without the active manipulation for the purpose of attaining and sustaining a high diversity of habitat and species, recovery of declining species may be slow or nonexistent. There would be continued use of the Forest on a maintenance level.

New trails could be built and some old trails would be closed with a net reduction in trail miles Forestwide. All trails would be closed to off-highway vehicles. Trails, roads and facilities causing degradation to streams would be upgraded, adequately maintained, relocated, or closed. Trout stocking would not be undertaken in this alternative, resulting in short and long-term beneficial effects on the aquatic community. Mineral extraction or development would be limited, especially surface-disturbing activities. Soil baring disturbances and erosion would be minimal.

Timber harvest would occur minimally and recreation facilities and developed sites would only be maintained. This reduction in sediment producing activities would have short and long-term beneficial effects on the riparian community. Prescribed fire and riparian disturbance would be minimal except for viability needs of certain land species. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the riparian community.

CUMULATIVE EFFECTS

There are no effects specific to this alternative beyond those previously described.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative emphasizes the maintenance of ecological processes and function while providing for multiple public benefits. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of riparian habitats, PETS species, and riparian-associated species. Viable populations of all native species would be attained and maintained when feasible. RCPA would be protected from damaging activities and degraded areas would be restored. In the short and long-term, this would provide for recovery of PETS species and would be very beneficial to the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in pursuit of it. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Vegetation manipulation for recreation may take place after meeting ecosystem needs. This alternative would increase bare soil disturbance (vegetation management) due to the viability needs of some riparian dependent species. In the short-term this would create localized adverse impacts due to the increase in sedimentation loads to the streams. In the long-term this vegetation management would benefit species dependent on this riparian habitat.

Although mineral development would be allowed in this alternative, development of federally owned minerals would not be actively pursued. Recreation (developed and dispersed) would remain at approximately current levels. Trails, roads and facilities that are causing degradation to riparian habitat would be upgraded, adequately maintained, relocated or closed. With the emphasis of attaining and sustaining a high diversity of habitats and species there would be a beneficial effect to riparian habitat dependent species. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Wildland fire use fire would an acceptable management tool. Wildland fires caused by humans would be suppressed. In the short-term these fires may cause an increase in sediment loads to adjacent streams. There should be long-term benefits through the establishment of a more diverse and stable riparian habitat.

The short-term establishment of a RCPA would have the long-term productivity effect of providing protected habitat for the riparian community.

CUMULATIVE EFFECTS

There are no effects specific to this alternative beyond those previously described.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

This alternative emphasizes the maintenance of ecological processes and function while providing for multiple public benefits with added emphasis on recreation. It provides for the establishment of a Riparian Corridor Prescription Area (RCPA), see description in Aquatic Species Viability, Alternative B-1. This RCPA will provide for protection of the aquatic habitat and will help reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings; this would also have both short-term and long-term beneficial effect.

Vegetation manipulation would take place for the purpose of attaining and sustaining a high diversity of riparian habitats, PETS species and riparian-associated species. Viable population of all native species would be attained and maintained when feasible. RCPA would be protected from damaging activities and degraded areas would be restored. In the short and long-term this would provide for recovery of PETS species and would be very beneficial to the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. No new sites would be considered for stocking, however. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

Vegetation manipulation for recreation may take place after meeting ecosystem needs. This alternative would increase bare soil disturbance (vegetation management) due to the viability needs of some riparian dependent species. In the short-term this would create localized adverse impacts due to the increase in sedimentation loads to the streams. In the long-term this vegetation management would benefit species dependent on this riparian habitat. Although mineral development would be allowed in this alternative, development of federally owned minerals would not be actively pursued.

Recreation (developed and dispersed) would remain near current levels. Approximately 75 miles of trails would be added to the Forestwide system. Trails, roads, and facilities causing degradation to riparian habitat would be upgraded, adequately maintained, relocated, or closed. The emphasis on attaining and sustaining a high diversity of habitats and species should benefit species that depend on riparian habitat. Alternative C-1 would give greater emphasis to recreation with long- and short-term detrimental effects on the riparian community. Funds would be shifted to recreation management while increased recreation activities and construction could disturb habitat and soil.

Prescribed fire may be applied appropriately to enhance and maintain biological diversity as well as sustain fire-dependent communities. Wildland fire use fire would be an acceptable management tool. Wildland fires by humans would be suppressed. In the short-term these fires may cause an increase in sediment loads to adjacent streams. There should be long-term benefits through the establishment of a more diverse and stable riparian habitat.

The short-term establishment of a RCPA would have the long-term effect of protecting riparian community habitat.

CUMULATIVE EFFECTS

None beyond those previously described.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize recreational opportunities to the extent possible. It would also establish a Riparian Corridor Prescription Area (RCPA) to protect aquatic habitat and reduce habitat fragmentation. Ownership fragmentation would be reduced through the purchase of inholdings with both short- and long-term benefits. Recreation activities would likely have adverse influences on ecological processes. Ecosystem diversity and sustainability would be maintained to meet minimum protection under the Endangered Species Act and the National Forest Management Act. Once the minimums were attained, however, actions would emphasize recreational opportunities to the extent possible. As a result, more RCPA would likely be disturbed by recreational activities.

Increased vegetation management and recreation for this alternative would result in an increase in habitat disturbance. With this increase in disturbance there would be long- and short-term adverse effects to riparian habitat dependent species. This would be due to the potential increase in roads, trails and facilities. Federal mineral development would be encouraged and the private minerals would be expected to remain the same as current levels. The increase in federal mineral development would also increase disturbance to the RCPA through the construction and use of roads, and possibly through the mineral construction site as well. These disturbances would have a long-term adverse effect on the riparian community. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. Also, other streams would be evaluated for additional trout stocking. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Trout would not be stocked in streams known inhabited by federally listed threatened or endangered species.

Ecosystem diversity and sustainability would be, at least, maintained to provide the minimum protection required by the Endangered Species Act and the National Forest Management Act. This would be beneficial, but additional efforts to attain and sustain a high diversity of habitat and species would be secondary to recreational needs and funds. Establishment of the RCPA provide long- and short-term benefits by reducing fragmentation and protecting streamside areas. Due to the priority given recreation, fewer funds would be available to promote habitat diversity. The RCPA would see more recreational development that could adversely affect the riparian community. Prescribed fire may be applied appropriately to enhance and maintain biological diversity and sustain fire-dependent communities. Wildland fire use fire would be an acceptable management tool. Wildland fires caused by humans would be suppressed. Such fires would have a short-term adverse effect from the increased disturbance of the riparian habitat. The enhancement and maintenance of biological diversity would provide long-term benefits.

The short-term establishment of a RCPA would have the long-term effect of protecting riparian community habitat.

CUMULATIVE EFFECTS

There would be no cumulative effects specific to this alternative beyond those previously described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the quality as well as quantity of resource products to maximize benefits to local and regional communities. It would establish a Riparian Corridor Prescription Area[10] (RCPA). The RCPA would generate long- and short-term benefits by reducing habitat fragmentation and protecting streamside areas. Ownership fragmentation would be reduced by the purchase of inholdings with both short-term and long-term beneficial effect.

The emphasis on commodities development could increase sedimentation levels in areas close to development activities with adverse effects on the riparian community in both the long- and short-term. Habitat fragmentation in the riparian area, stream reaches, and populations would increase as more trails, roads, facilities, and mineral extraction sites were developed. These would create additional adverse long- and short-term impacts. Trout stocking would be maintained at the current level as long as it did not interfere with the viability of native species. There could be long- and short-term adverse effects from the continued introduction of this non-native species and from the public's impacts in their pursuit of this species. The short-term use of stocking trout may affect long-term productivity of those streams by reducing the genetic diversity and number of aquatic organisms available to repopulate the stream if trout were removed. Additional streams would be evaluated for trout stocking. Trout would not be stocked in streams known to be inhabited by federally listed threatened or endangered species.

Ecosystem diversity and sustainability would be maintained to meet the minimum protection required by the Endangered Species Act and the National Forest Management Act. This would be beneficial, but only at minimal levels. Additional efforts to attain and sustain a high diversity of habitat and species would be secondary to resource products needs and funding. All wildland fires would be suppressed to prevent resource damage. Prescribed fire would be used to improve plant and wildlife habitat, reduce fuels to prevent wildland fire, and prepare sites for planting or natural regeneration. While such fires would have a short-term adverse effect by causing disturbances within the RCPA, there would be long-term benefits from the enhancement and maintenance of biological diversity.

The short-term establishment of an RCPA would have the long-term benefit of providing protected habitat for riparian-associated species.

CUMULATIVE EFFECTS

There would be no effects specific to this alternative beyond those previously described.

[10] See description in Alternative B-1.

PROPOSED, ENDANGERED, THREATHENED, AND SENSITIVE SPECIES

Affected Environment

The DBNF currently monitors the effects of management actions on 32 species listed under the Endangered Species Act as "Threatened or Endangered" (Table 3 - 54). These species either now occur or have occurred on National Forest System lands or within the DBNF proclamation boundary. This species list is updated as needed and reviewed annually with the U.S. Fish and Wildlife Service (USFWS). Currently there are no species on National Forest System lands or within the DBNF proclamation boundary classified as "Proposed" for federal listing.

Table 3 - 54. Federally listed species for the DBNF.

Group	Common Name	Status	Prescription Areas Important to the Species
Mammal	Gray bat	E	1C – 1E – 1J
	Indiana bat	E	1C – 1E – 1J – 1K
	Virginia big-eared bat	E	1C – 1E – 1J –1K
Bird	Bald eagle	T	1E – 3B
	Red-cockaded woodpecker	E*	1K
Fish	Duskytail darter	E	1E
	Palezone shiner	E	1E
	Blackside dace	T	1E
Mussel	Cumberland elktoe	E	1E
	Fanshell	E	1E
	Dromedary pearlymussel	E*	1E
	Cumberlandian combshell	E	1E
	Oyster mussel	E	1E
	Yellow blossom	E*	1E
	Tan riffleshell	E	1E
	Catspaw	E*	1E
	Northern riffleshell	E	1E
	Tubercled blossom	E*	1E
	Cracking pearlymussel	E*	1E
	Pink mucket	E	1E
	Ring pink	E*	1E
	Little-wing pearlymussel	E	1E
	Clubshell	E*	1E
	Rough pigtoe	E*	1E
	Cumberland bean pearlymussel	E	1E
Plant	Cumberland sandwort	E	1C
	Cumberland rosemary	T	1E
	Eggert's sunflower	T	1K
	American chaffseed	E	1C – 1G – 1K
	White-haired goldenrod	T	1C – 3E
	Virginia spiraea	T	1E
	Running buffalo clover	E	1E – 1K

Status Codes: 'E'= species is listed as 'Endangered' under the Endangered Species Act; 'T' = species is listed as 'Threatened' under the Endangered Species Act; 'E*' means species is considered by USFWS as extirpated from DBNF.

As part of compliance with the Endangered Species Act, projects conducted on the DBNF receive site-specific analysis for impacts to each of the 32 species federally listed as Threatened or Endangered. Consultation with the U.S. Fish and Wildlife Service (USFWS) is conducted prior to project implementation.

Federal Candidate Species

Four species found on the DBNF are designated as "Candidate" species. These are species for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (Table 3 - 55). These four species are also included on the Regional Forester's Sensitive species list for the DBNF. Thus, candidate species receive full consideration in the decision making process in order to ensure their viability and to preclude trends toward federal listing

Table 3 - 55. Federal candidate species for the DBNF.

GROUP	COMMON NAME	STATUS
Fish	Cumberland Johnny darter	C
Mussel	Fluted kidneyshell	C
Plant	White-fringeless orchid	C
Plant	Short's bladderpod	C

Status 'C' = the species is a candidate species for consideration of federal listing by the USFWS.

Sensitive Species

Within the DBNF proclamation boundary, the Regional Forester has designated 71 species whose range-wide viability is of concern. This list is titled the Regional Forester's Sensitive Species List. Those species, which occur or have suitable habitat on the DBNF, are shown in Table 3 - 56. This list took effect August 7, 2001, and does not require a Plan Amendment to become official. Sensitive species receive full consideration in decision making to ensure their viability and to preclude trends toward federal listing.

Table 3 - 56. Regional Forester's Sensitive Species List for the DBNF.

Group	Common Name	Prescription Areas Important to the Species
Mammal	Rafinesque's big-eared bat	1C – 1J – 1K
	Southeastern myotis	1C – 1E – 1J
	Eastern small-footed bat	1C – 1E – 1J – 1K
	Long-tailed shrew	1C – 1K
Bird	Bachman's sparrow	1K
	Peregrine falcon	1C – 1K
	Appalachian Bewick's wren	1K
Fish	Western sand darter	1E
	Eastern sand darter	1E
	Cumberland Johnny darter	1E
	Ashy darter	1E
	Spotted darter	1E
	Tippecanoe darter	1E
	Mountain brook lamprey	1E
	Northern madtom	1E
	Blotchside logperch	1E
	Longhead darter	1E
	Olive darter	1E
	Southern cavefish	1E
Mussel	Cumberland papershell	1E
	Spectaclecase	1E
	Snuffbox	1E
	Long-solid	1E
	Tennessee clubshell	1E
	Pyramid pigtoe	1E
	Fluted kidneyshell	1E
	Rabbitsfoot	1E
	Salamander mussel	1E
	Purple lilliput	1E
	Sheepnose	1E
Snail	Glossy supercoil	1K
	Shortspire hornsnail	1E
	Domed ancylic	1E
	Delicate vertigo	1C – 1K
	Cupped vertigo	1C – 1K
Crustacean	Big South Fork crayfish	1E
Insect	Helma's net-spinning caddisfly	1E
	Cliffline caddisfly	1C
	Pygmy snaketail	1E
	Appalachian grizzled skipper	1K
	Diana fritillary	1K
	Regal fritillary	1K
Vascular plant	Rockcastle aster	1E
	Spreading yellow false foxglove	1C – 1K
	American barberry	1E
	Juniper sedge	1G
	Small spreading pogonia	1C – 1K
	Stoneroot	1E – 1K
	Kentucky lady's slipper	1E
	French's shooting star	1C
	Mountain heartleaf	1E
	Butternut	1E – 1K
	Short's bladderpod	1C – 1G
	Large-flowered Barbara's buttons	1E
	Sweet pinesap	1C – 1K
	Canby's mountain-lover	1C
	White fringeless orchid	1G
	Bay starvine	1C – 1E
	Rock skullcap	1C – 1E
	Southern Oconee bells	3E
	Blue Ridge catchfly	1K
	Royal catchfly	1G – 1K
	Little mountain meadowrue	1C – 1E
	Cutleaved meadow parsnip	1K
	Sand grape	1E
	Hairy skullcap	1C – 1E – 1K
Nonvascular plant	Closter's brook-hypnum	1E
	Plagiochila austinii (a liverwort)	1C
	Sullivant's leafy liverwort	1C
	Radula sullivantii (a liverwort)	1C
	Agoyan cataract moss	1C – 1E

For the purpose of analysis in this Draft Environmental Impact Statement, affected environment is the area within the DBNF proclamation boundary.

Indicators used to evaluate effects to PETS species include the establishment of Prescription Areas designed to protect or enhance the habitat used by these species and the resulting likelihood of moving PET species populations toward recovery and to ensure Sensitive species viability and preclude their trend toward federal listing.

Environmental Effects

RESOURCE TABLES

Few PETS species are entirely dependent upon habitat present in any single Prescription Area. However, several of these Prescription Areas have been created primarily for the purpose of protecting or enhancing the habitat condition upon which these species depend, while others provide a variety of habitats even if that is not their primary purpose. Most PETS species on the DBNF reside for all or a large part of their lives in these Prescription Areas. Table 3 - 57 provides a comparison between acres in these Prescription Areas and the alternatives being considered for the 2004 Forest Plan. Programmatic consequences of general management direction associated with Prescription Areas are summarized in Table 3 - 58.

Table 3 - 57. Prescription Areas with PETS Species habitat acreage provided by alternative.

PRESCRIPTION AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
1.C. Cliffline Community	111,205	111,205	111,205	111,205	111,205	111,205
1.E. Riparian Corridor	0	155,379	155,379	155,379	155,379	155,379
1.G. Rare Community	0	1,200	1,200	1,200	1,200	1,200
1.I. Designated Old-Growth	0	0	15,331	15,331	15,331	325
1.J. Significant Bat Caves	6,115	6,115	6,115	6,115	6,115	6,115
1.K. Habitat Diversity Emphasis	0	0	386,577	376,042	376,042	0
1.M. Custodial	0	394,163	0	0	0	0
2.A. Clifty Wilderness	12,646	12,646	12,646	12,646	12,646	12,646
2.B. Beaver Creek Wilderness	4,791	4,791	4,791	4,791	4,791	4,791
3.C.1. Red River W&S River Wild River Segment	863	863	863	863	863	863
3.C.3. Red River W&S River Recreational Segment	2,114	2,114	2,114	2,114	2,114	2,114
3.C.4. Proposed W&S River: Cumberland River, War Fork Creek, Rockcastle River -Scenic Rivers	5,622	5,622	5,622	5,622	5,622	5,622
3.C.5. Proposed W&S River: Rock Creek and Marsh Creek – Recreational Rivers	6,184	6,184	6,184	6,184	6,184	6,184
3.E. Red River Gorge Geological Area & National Natural Landmark	29,298	29,298	29,298	29,298	29,298	29,298
4.A. Timber Products	0	0	0	0	0	394,916
4.B. General Forest Area 1985 Plan	568,206	0	0	0	0	0

Table 3 - 58. Relative opportunity for Prescription Areas to benefit PETS species by alternative.

PRESCRIPTION AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
1.C. Cliffline Community	2	2	2	2	2	2
1.E. Riparian Corridor	NA	3	3	3	2	3
1.G. Rare Community	NA	3	3	3	3	3
1.I. Designated Old-Growth	NA	1	3	3	3	3
1.J. Significant Bat Caves	2	3	3	3	3	3
1.K. Habitat Diversity Emphasis	N/A	N/A	3	3	3	N/A
1.M. Custodial	N/A	1	N/A	N/A	N/A	N/A
2.A&B. Wilderness	2	2	2	2	2	2
3.C. W&S Rivers	2	2	2	2	2	2
3.E. Red River Gorge Geological Area & National Natural Landmark	2	2	2	2	2	2
4.A. Timber Products	N/A	N/A	N/A	N/A	N/A	1
4.B. General Forest Area	2	N/A	N/A	N/A	N/A	N/A

3 = a programmatic increase in PETS species protection or habitat enhancement opportunities

2 = a programmatic no change in PETS species protection or habitat enhancement opportunities

1 = a programmatic decrease in PETS species protection or habitat enhancement opportunities

Potential impacts to PETS species can be very site-specific and individual project oriented. However, some programmatic consequences can be anticipated regarding general management emphasis associated with a particular alternative. Relative comparisons between existing Forest Plan direction and direction found in various alternatives is shown in Table 3 - 59.

Table 3 - 59. Relative opportunity to protect or benefit PETS species by functional area and alternative.

FUNCTIONAL AREA	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Recreation	2	3	3	2	1	2
Roads and trails	2	3	3	3	1	1
Fire	2	1	3	3	3	1
Minerals	2	3	3	3	2	1
Land adjustment	2	2	3	3	1	1

3 = a programmatic increase in PETS species protection or habitat enhancement opportunities

2 = a programmatic no change in PETS species protection or habitat enhancement opportunities

1 = a programmatic decrease in PETS species protection or habitat enhancement opportunities

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Several Prescription Areas utilized by PETS species remain essentially unchanged throughout all alternatives. These include Cliffline Community (1.C), Significant Bat Caves (1.J), Clifty Wilderness (2.A), Beaver Creek Wilderness (2.B), Red River Wild and Scenic River (3.C.1, 3.C.2), proposed Wild and Scenic River segments (3.C.4), and Red River Gorge Geological Area (3.E). Thus, differences in effects among alternatives do not exist for these Prescription Areas.

Site-specific analysis, through biological evaluation, would continue for proposed projects regardless of alternative. Likewise, monitoring of PETS species will be conducted according to Forest Plan and Handbook and is independent of alternative selection.

Short-term use and long-term productivity are common to all alternatives. Regardless of the alternative chosen, all projects implemented under the 2004 Forest Plan will be designed to avoid negative impacts to the long-term productivity of any PETS species population on the DBNF. Some activities designed to attain a Desired Future Condition within a Prescription Area could have short-term impacts to individual PETS species. The short-term impacts, both positive and negative, are evaluated and disclosed through second-level, site-specific analysis. Long-term productivity of PETS species populations should be enhanced through attainment of the Desired Future Condition associated with each Prescription Area.

CUMULATIVE EFFECTS

Land ownership within the DBNF proclamation boundary is highly interspersed between private, state, and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur off National Forest System land within the proclamation boundary is not likely to differ regardless of alternative. Private land uses such as farming, timber harvest, or mineral development are likely to occur at a time, place, and rate unrelated to National Forest System land management. In addition, actions on National Forest System lands authorized by other federal agencies (e.g., federal highways) are not expected to vary by alternative. Thus, alternative selection is unrelated to differences associated with these types of potential cumulative effects.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Several Prescription Areas, important to the maintenance or recovery of PETS species populations, would not exist under this alternative. These include Riparian Corridor, Rare Community, and Designated Old-Growth. Thus, programmatic benefits associated with management direction of these Prescription Areas would not occur.

With the absence of a Riparian Corridor Prescription Area, this alternative would likely see adverse impacts to aquatic PETS species associated with recreation, roads, trails, and other uses.

CUMULATIVE EFFECTS

There are none beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Alternative B-1 would emphasize custodial management. Some habitat management could occur within selected Prescription Areas, but overall these activities would be greatly limited in size and scope. The General Forest, Timber Products, and Habitat Diversity Emphasis Prescription Areas would not exist under this alternative. The selection of this alternative would result in a substantial reduction in acres actively managed to enhance terrestrial PETS species habitats. However, this alternative would also see the least amount of soil disturbance and the resulting potential for stream sedimentation. Thus, potential sedimentation impacts to aquatic species would be minimized under this alternative.

The Custodial Prescription Area (1M) would occur only in Alternative B-1. This prescription would call for very little habitat management, and the Forest would head slowly in the direction of older forest communities. PETS species that require younger age forest habitat or benefit from forest vegetation management tools such as prescribed fire would experience continuing declines in available habitat. Habitat management necessary only for minimum viability would be undertaken. For example, prescribed burning would be limited to only about 2,000 acres annually, and fire adapted species would likely decline from present levels in distribution and abundance.

The custodial management emphasis would likely reduce the amount of dispersed recreation on the DBNF, somewhat reducing potential harm to PETS species from human interactions.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE C

DIRECT AND INDIRECT EFFECTS

This alternative would emphasize the maintenance of ecological processes and function. Species needs, including PETS species, would be the fundamental objective of habitat management. The Habitat Diversity Emphasis Prescription Area would support a wide variety of habitat conditions across the Forest. Its primary goal would be the provision of habitat components necessary to enhance, not simply provide, habitat suitability for PETS and other species. The opportunity to move species toward recovery goals would be maximized under this alternative.

Alternative C would anticipate essentially the same recreational use that now occurs. Additional Standards, particularly within the Riparian Corridor Prescription Area, would be implemented to reduce the likelihood of adverse human impacts on PETS species. Programmatic direction within this Prescription Area would provide additional safeguards for PETS species, minimizing the potential for adverse impacts.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE C-1

DIRECT AND INDIRECT EFFECTS

Alternative C-1 would emphasize the maintenance of ecological processes and function with additional emphasis on recreation. Species needs, including PETS species, would serve as the fundamental objective of habitat management. The Habitat Diversity Emphasis Prescription Area would support a wide variety of habitat conditions across the Forest. Its primary goal would be the provision of habitat components necessary to enhance, not simply provide, habitat suitability for PETS and other species. The opportunity to move species toward recovery Goals will be very similar to that of Alternative C.

Alternative C-1 would anticipates some increase in recreational use over that in Alternative C. Additional Standards, particularly within the Riparian Corridor Prescription Area, would be implemented to reduce the likelihood of adverse human impacts on PETS species. Additional road and trail Standards would be applied within this Prescription Area to provide programmatic safeguards for PETS species. Impacts to PETS species would be very similar to those associated with Alternative C.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE D

DIRECT AND INDIRECT EFFECTS

Alternative D emphasizes recreational opportunities to the maximum extent possible. Although the Prescription Areas remain essentially unchanged from those included in Alternatives C and C-1, management emphasis is directed toward recreational pursuits. Thus, habitat enhancement to recover PETS species would not be as high a priority as in either Alternative C or C-1.

Recreation activities such as road and trail construction would receive additional emphasis under this alternative. Thus, there would be potential for increased stream sedimentation from these sources when compared to the other alternatives. Alternative D would include the Riparian Corridor Prescription Area with the same provisions for protecting water quality as are found in the other alternatives, excluding Alternatives A and B-1. Dispersed recreation would be maximized in this alternative, giving it the greatest potential of any alternative for adverse recreation-related impacts to PETS species and their habitats.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

The primary purpose of habitat manipulation under this alternative would commodity production rather than PETS species habitat restoration. A Prescription Area dedicated to timber production (4.A) would be established only in Alternative E. The 1985 Plan (Alternative A) contains a somewhat similar, although substantially larger Prescription Area designated as General Forest, 4.B. This alternative would not create a Prescription Area designed to maintain habitat diversity. Thus, the potential to emphasize PETS species habitat management would be substantially less under Alternative E-1 than under alternatives with the 1.K Habitat Diversity Prescription Area.

Recreational use would be emphasized in this alternative primarily through the fee use system. The potential for impacts to PETS species, through increased dispersed recreation, would likely be less than that under Alternative D, but would still be higher than in any other alternative.

CUMULATIVE EFFECTS

None beyond those already described in Effects Common to All Alternatives.

DEMAND SPECIES

Affected Environment

Current direction emphasizes the protection, enhancement, and maintenance of species and their habitats, which in turn will provide diverse opportunities for users of wildlife and fish resources. The "demand" label does not imply that a species is of greater value than a "non-demand" species. All species are always "in demand" for one or more reasons (e.g., ecological, scientific, ethical, aesthetic, recreational, commercial, legal). However, for the purpose of this chapter, "demand species" are those most associated with the recreational wildlife pursuits; i.e. hunting, fishing, and viewing activities (Table 3 - 60). Since these activities are generally limited or restricted on non-public lands, the DBNF offers a unique opportunity to those wishing to participate in these activities.

Table 3 - 60. Demand species list for the DBNF.

SPECIES GROUP	SPECIES	HABITAT GROUP	TYPE OF DEMAND
Amphibian	Bullfrog	Aquatic	Hunting
Fish	Black bass	Aquatic	Fishing
	Catfish sp.	Aquatic	Fishing
	Crappie	Aquatic	Fishing
	Muskellunge	Aquatic	Fishing
	Panfish (e.g. Bluegill, Sunfish)	Aquatic	Fishing
	Trout	Aquatic	Fishing
	Walleye	Aquatic	Fishing
	White bass	Aquatic	Fishing
Bird	Mourning dove	Terrestrial	Viewing/Hunting
	Passerine birds (Songbirds)	Terrestrial	Viewing
	Northern Bobwhite Quail	Terrestrial	Viewing/Hunting
	Ruffed grouse	Terrestrial	Viewing/Hunting
	Waterfowl	Terrestrial but utilizes Aquatic	Viewing/Hunting
	Wild turkey	Terrestrial	Viewing/Hunting
	Woodcock	Terrestrial	Viewing/Hunting
	Bald eagle	Terrestrial	Viewing
Mammal	Beaver	Terrestrial but utilizes Aquatic	Viewing/Trapping
	Black bear	Terrestrial	Viewing
	Bobcat	Terrestrial	Hunting/Trapping
	Elk	Terrestrial	Viewing/Hunting
	Gray fox	Terrestrial	Hunting/Trapping
	Gray squirrel	Terrestrial	Viewing/Hunting
	Mink	Terrestrial	Trapping
	Muskrat	Terrestrial but utilizes Aquatic	Trapping
	Rabbit	Terrestrial	Viewing/Hunting
	Raccoon	Terrestrial	Hunting/Trapping
	White-tailed deer	Terrestrial	Viewing/Hunting

The level of demand for each species or group of species varies to some degree across the Forest. Consumptive demand for species includes hunting, fishing, and trapping. A level of demand is also recognized for non-consumptive uses such as viewing, which enhances the experience of forest users.

Wildlife on the DBNF is cooperatively managed under an agreement with the Kentucky Department of Fish and Wildlife Resources (KDFWR). The agreement recognizes the Forest's responsibility "to practice forms of land and resource management that will benefit wildlife (habitats) as much as

practical in coordination with the requirements of other uses and values." The agreement also recognizes KDFWR's responsibility as "the agency primarily responsible for protection and management of the Forest's wildlife (species) resources." In fulfilling the Forest's commitment under the agreement, the DBNF manages habitats for native and desirable non-native plants, fish, and wildlife species. Because the alternatives address land and resource management only on lands administered by the DBNF, this analysis of demand species is limited to National Forest System land.

Five state-designated Wildlife Management Areas lie within the Forest. KDFWR hunting regulations are applied within these areas to improve and sustain populations and meet wildlife management objectives. In addition to the recreational opportunities provided by these areas, they also serve as source population centers for restocking efforts in the state.

Hunting

To be considered huntable by the KDFWR, species must have population levels that produce some harvestable surplus. Kentucky's public lands are recognized as an important part of the land base to provide quality-hunting areas. Surveys by the KDFWR indicate that 80 percent of the annual deer harvest occurs on private lands. However, the remaining 20 percent of the harvest occurs on public lands that comprise only about five percent of the state's hunting areas. This indicates a high use of public lands for white-tailed deer hunting.

Between 1991 and 1996, hunter use days on National Forests in the Southern Region increased by about 23 percent and the expenditures (retail sales for related goods and services) have increased by over 88 percent (Maharaj 2000). Information from the KDFWR indicates that the number of licensed hunters in Kentucky has remained flat to slightly declining while hunter use days have increased. The number of statewide hunting participants between 1991 and 1996 has shown essentially no change (USFWS 1998).

Fishing

The demand for quality fishing opportunities in Kentucky has remained high as indicated by the number of fishing license sales reported by KDFWR. Between 1991 and 1996, the number of fishing participants has shown essentially no change (USFWS 1998).

The average Kentucky angler fishes about 24 days each year (1990-1991season), 15 percent more than the national average. Fishing from a boat is the method used 58 percent of the time, but non-boat fishing is still very popular. Anglers fished large reservoirs, lakes, and farm ponds (under 10 acres) most often. Cave Run Lake and Laurel River Lake are in the top 12 most fished lakes in the state. Black bass (largemouth, smallmouth, and spotted bass) are the most popular fishes in Kentucky. Fishing for muskie, walleye, and trout occurs in higher percentages in eastern Kentucky than elsewhere in the state.

A fishing trip's quality is usually measured subjectively by "the enjoyment of fishing," although the number of fish caught remains an important factor, especially when considering a return visit. Nearly half of anglers believe that habitat and water quality are the most important factors affecting fish populations. Fisheries projects that focus on habitat rehabilitation, enhancement, protection, and watershed management receive strong support from the angling public.

Trout (brown and rainbow) are generally recognized as a valuable recreational aquatic resource. All streams currently being stocked with trout on the Forest are considered put-and-take or put-grow-and-take fisheries. Numerous waters located on the DBNF are stocked with rainbow trout by the U.S. Fish and Wildlife Service and brown trout by the KDFWR and the U.S. Fish and Wildlife Service (Table 3 - 61).

Table 3 - 61. Waters currently stocked with trout on the DBNF.

WATERS	COUNTY	RAINBOW TROUT	BROWN TROUT
Bark Camp Creek	Whitley	X	X
Big Double Creek	Clay	X	
Cane Creek	Laurel	X	
Cave Run Lake	Bath and Rowan	X	
Chimney Top Creek	Wolfe		X
Craney Creek	Rowan	X	
East Fork Indian Creek	Menifee	X	X
Fishing Derby Ponds	Forest -wide	X	
Laurel River	Laurel and Whitley	X	X
Laurel River Lake	Laurel and Whitley	X	X
Little Double Creek	Clay	X	
Middle Fork Red River	Powell	X	
Minor Creek	Rowan		X
North Fork Triplett Creek	Rowan	X	
Rock Creek	McCreary	X	
Slabcamp Creek	Rowan		X
Swift Camp Creek	Wolfe	X	
Triplett Creek	Rowan	X	
War Fork	Jackson	X	

Viewing

The opportunity to view and observe wildlife is an integral and important part of many recreational activities such as hiking, hunting, fishing, camping, driving, and other outdoor activities. This factor is often identified as one criteria applied in personally evaluating the success of an outdoor experience. Rare opportunities to view little known species are also a benefit of the Forest. A disproportionately higher number of forest-associated rare species can typically be found on National Forest System lands.

The trend in the number of viewing days on National Forests in the Southern Region showed a slight decrease between 1991 and 1996. A decrease of about two percent in viewing days and 14 percent in expenditures was observed (Maharaj 2000). This follows the nationwide trend for the same period; however, the southern region showed less reduction in viewing days than was observed nationwide (16 percent). Statewide, between 1991 and 1996, the number of participants who traveled at least one mile from their residence to view wildlife remained unchanged; however, the number of participants who typically viewed wildlife near their residences declined by 20 percent (USFWS 1998).

In the spring of 1995, the University of Minnesota conducted a survey of managers on national forests throughout the nation to determine the relative importance of forest ecosystem attributes, outputs, and functions as perceived by national forest managers (Zhi Xu and Bengston 1996). Of the 19 national forest attributes identified, respondents ranked timber, wildlife and fish habitats, consumptive, and non-consumptive recreation as the top four in importance, respectively, in the Southern Region.

Viewing and photographing wildlife is the most popular non-consumptive wildlife-related activity found on the Forest. About 31 percent of the people surveyed in the National Survey on Recreation and the Environment (Fenton 1997) participated in wildlife viewing/photography and slightly fewer, 27 percent, concentrated particularly on viewing and photographing birds. The variety of wildlife viewing, photography, and study opportunities will be sustained through the planning period only to the extent that habitat diversity is maintained. Public lands of the DBNF will play an ever-increasing role in meeting the needs of outdoors enthusiasts.

To provide for the habitats of the species and groups listed in Table 3 - 60, the habitat types utilized by these species must be provided. Several of the species or groups have very specific habitat requirements; while others require a variety of habitats; while still others are very opportunistic and adaptable and can thrive in a variety of habitat types and conditions. Multiple habitat types may be necessary for some species throughout their life cycle.

The following general relationships exist for each species or group (Table 3 - 62).

Table 3 - 62. Habitats most commonly used by demand species on the DBNF.

Species Group	Species	Grassy Openings	Wooded Grasslands/ Shrublands (Pine)	Wooded Grasslands/ Shrublands (Hardwood)	Early Successional 0-10 yrs	PoleS/ Sapling 11-50 yrs	Hard Mast and Den Producing 50+ yrs	Riparian1	Aquatic	Diversity of habitats2
Amphibian	Bullfrog							X	X	
Bird	Bald eagle							X	X	
Bird	Mourning dove	X								
Bird	Other waterfowl	X						X	X	
Bird	Passerine birds (songbirds)	X	X	X	X	X	X	X		X
Bird	Quail	X			X					
Bird	Ruffed grouse				X	X				
Bird	Wild turkey	X					X			X
Bird	Wood duck						X	X	X	
Bird	Woodcock	X				X		X		
Fish	Black bass								X	
Fish	Catfish sp.								X	
Fish	Muskellunge								X	
Fish	Panfish (e.g. Sunfish, Bluegill)								X	
Fish	Trout spp.								X	
Fish	Walleye								X	
Fish	White bass								X	
Fish	Crappie								X	
Mammal	Black bear									X
Mammal	Bobcat									X
Mamma	Beaver							X	X	
Mammal	Elk	X								
Mammal	Gray fox									X
Mammal	Gray squirrel			X			X			
Mammal	Mink							X		
Mammal	Muskrat							X	X	
Mammal	Rabbit	X			X					
Mammal	Raccoon						X	X		X
Mammal	White-tailed deer	X	X	X	X		X			X

[1] For the demand species analysis, the term riparian refers to Eastern riverfront and river flood plain forested habitats and should not be confused with the Riparian Corridor Prescription Area.

[2] Indicates species will utilize a wide range of habitat types.

Because a Forest Plan provides programmatic, rather than site-specific, direction, this analysis is based on a general comparison of expected changes to associated habitat types. Environmental effects of the alternatives on demand species will be based on the number of acres of demand species habitat available at out-years 10 and 20 compared to acres currently available (Table 3 - 63). It assumes that an increase or decrease in the quantity of habitat will result in a corresponding change in populations and, in turn, a corresponding increase or decrease in the opportunity for a successful experience. There are limitations to this assumption, however. Populations are affected by many factors, such as hunting/fishing regulations; access; numbers and success of hunters/anglers; supplemental stocking of species; quality and juxtaposition of habitats; climatic conditions; insects and disease; inter and intra specific competition; and land management practices on adjacent lands. At the Forest Plan level of analysis, the factors affecting populations cannot be meaningfully measured, detected, or evaluated. Therefore, they are better left for project-specific or site-specific analysis.

Environmental Effects

RESOURCE TABLE

Table 3 - 63. Habitat currently available for demand species on the DBNF.

General Habitat Type	Acres/Miles Currently Available[1]
Grassy Openings	2171 Acres
Wooded Grasslands/Shrublands (Pine)	0 Acres
Wooded Grasslands/Shrublands (Hardwood)	0 Acres
Early successional (0-10 yrs)	56,171 Acres
Poles/Sapling (11-50 yrs)	155,360 Acres
Mast/Den producing (50+ yrs)	212,421 Acres
Riparian[2]	4,004 Acres
Aquatic – lakes	13,853 Acres
Aquatic – perennial streams	2,516 Miles

[1]Data used in this analysis were derived from the 1997 Continuous Inventory of Stand Conditions database (CISC) and the Geographic Information System (GIS). Acres are based on GIS stand polygons. Acres used in this analysis are for NF land only.

[2]For the demand species analysis, the term riparian refers to Eastern riverfront and river flood plain forested habitats and should not be confused with the Riparian Corridor Prescription Area.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Kentucky Department of Fish and Wildlife Resources (KDFWR) is responsible for the permanent and continued supply of the wildlife resources of Kentucky. Regardless of the alternative selected, KDFWR will continue to regulate hunting/fishing seasons; bag, creel, and possession limits; buying, selling, and transporting fish and wildlife; methods and devices used to take fish or wildlife; and sets areas for hunting and fishing activities. To a lesser extent, KDFWR will also continue to regulate viewing opportunities, such as their regulation(s) prohibiting the use of lights to view wildlife at night.

Riparian/Lakes/Streams

An increase in the amounts of riparian area, lakes, and streams can be accomplished only through the acquisition of additional land. Throughout all alternatives, acres in these habitat types would be expected to remain stable. All alternatives would be able to provide good quality aquatic habitat capable of supporting recreational fishing opportunities.

CUMULATIVE EFFECTS

Land ownership within the DBNF Proclamation Boundary is highly interspersed between private, state, and federal entities. On a landscape scale of this proportion, the effects of the myriad actions that could occur off National Forest System lands within the proclamation boundary are not likely to differ regardless of alternative. Private land uses such as farming, timber harvest, or mineral development are likely to occur at a time, place, and rate independent of the selection of Forest Plan alternatives.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

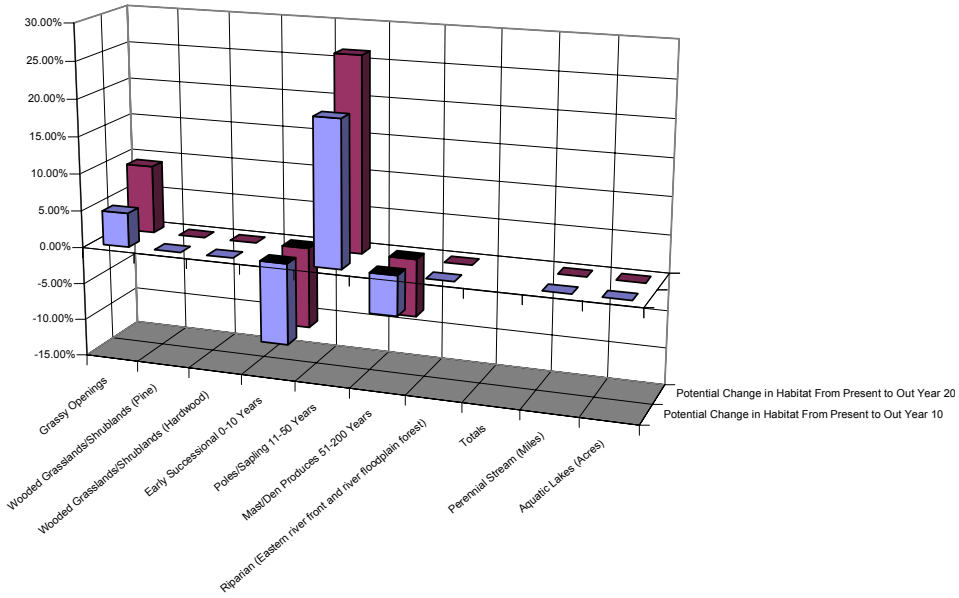

Figure 3 - 38. Potential Change in Habitat Types for Alternative A.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	4.61%	0.00%	0.00%	-10.99%	19.68%	-5.43%	0.00%	0.00%	0.00%
Potential Change in Habitat through Year 20	9.21%	0.00%	0.00%	-10.99%	26.39%	-7.78%	0.00%	0.00%	0.00%

Openings/Grassy

In addition to the existing acres, an increase of approximately 100 acres in the first decade of Plan implementation could be expected. These areas would be considered permanent and maintained in the grassy opening state. At the end of the first decade, grassy openings would comprise of less than one percent of demand species habitat.

Wooded Grasslands/Shrubland (Both Pine and Hardwood)

These types of habitat would not be created/maintained under this alternative.

Early Successional (trees 0-10 years old)

An increase of approximately 50,000 acres of this habitat type could be expected in the first decade with a leveling off during the second decade of plan implementation. The majority of the acres would be created as a result vegetation management activities primarily in the poles/saplings and mast/den types of habitat. At the end of the first decade, approximately 12 percent of demand species habitat would be of this type.

Poles/Saplings (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during each of the first two decades of plan implementation could be expected. At the end of the first decade, approximately 38 percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

As a result of vegetation management activities, a decrease of approximately 11,300 acres during the first decade and approximately 14,000 acres during the second decade of plan implementation could be expected. At the end of the first decade, approximately 49 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

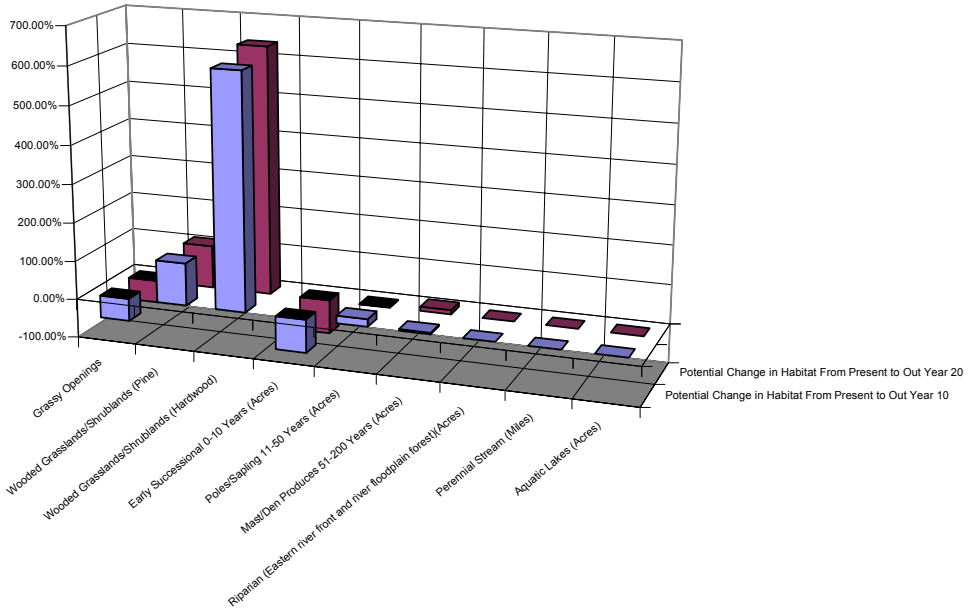

Figure 3 - 39. Potential Change in Habitat Types for Alternative B-1.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-58.54%	110.00%	610.00%	-86.26%	19.68%	3.95%	0.00%	0.00%	0.00%
Potential Change in Habitat through Year 20	-58.54%	110.00%	640.00%	-87.32%	-1.29%	11.11%	0.00%	0.00%	0.00%

Openings/Grassy

A gradual decrease of approximately 1,300 acres of this habitat type would occur in the first 10 years of Plan implementation. These 1,300 areas would probably be nonexistent by the end of the second decade. The decrease can be attributed to the areas being overtaken by woody vegetation. In order to meet viability requirements, approximately 900 acres of this habitat type would be maintained across the Forest. At the end of the first decade, less than one percent of demand species habitat would consist of this type. While other, smaller areas may be produced by natural disturbances, they would be short lived.

Early Successional (trees 0-10 years old)

In order to meet viability requirements, approximately 700 acres of this habitat type would be maintained across the Forest. At the end of the first decade, approximately two percent of demand species habitat would consist of this type. While other, smaller areas may be produced by natural disturbances, they would be short lived.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be established in the first decade and maintained throughout the second decade. While other, smaller areas could be produced by natural disturbances, they would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. While other, smaller areas could be produced by natural disturbances, they would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Poles/Sapling (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during the first decades, and an additional decrease of approximately 37,400 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately forty percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

An increase of approximately 9,000 acres of this habitat type would occur in the first decade, and an additional increase of 17,600 acres during the second decade of Plan implementation. At the end of the first decade, approximately 57 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of trout stocking would be inconsistent with the management emphasis of this alternative and would not be encouraged. Should KDFWR and FWS cease stocking trout, trout fishing opportunities would likely decline as a result of previously stocked trout being caught and/or through natural mortality. At some point, trout fishing opportunities would no longer exist on the Forest.

CUMULATIVE EFFECTS

None beyond those described in the Effects Common to All Alternatives discussion.

ALTERNATIVES C, C1, D

DIRECT AND INDIRECT EFFECTS

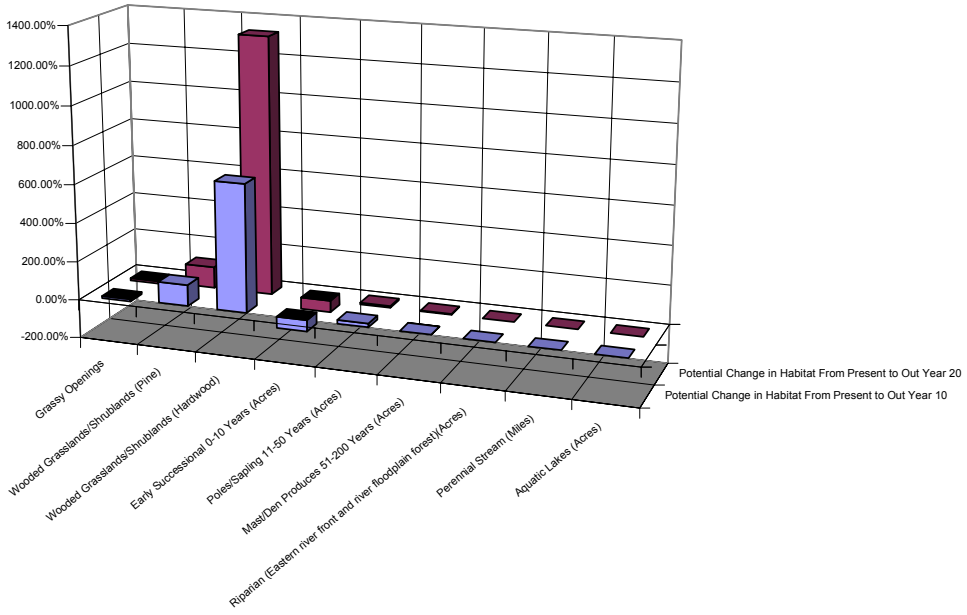

Figure 3 - 40. Potential Change in Habitat Types for Alternative C, C1, D.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-12.48%	110.11%	660.0%	-58.97%	19.68%	0.55%	0.0%	0.0%	0.0%
Potential Change in Habitat through Year 20	-12.50%	110.11%	1330.0%	-59.10%	8.50%	4.20%	0.0%	0.0%	0.0%

Openings/Grassy

A gradual decrease of approximately 270 acres of this habitat type would occur in the first decade of implementation. Acres remaining/created in this habitat type would be considered permanent and maintained in an open state. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Early Successional (trees 0-10 years old)

An increase of approximately 3,900 acres of this habitat type would occur in the first ten years. Approximately 22,000 acres of this habitat type would be maintained across the forest throughout the second decade. The increase of acres would be primarily a result of vegetation management activities. At the end of the first decade, approximately five percent of demand species habitat would be of this type.

Poles/ Saplings (trees 10-50 years old)

As a result of maturing timber, a decrease of approximately 7,700 acres during the first decades, and an additional decrease of 24,000 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately 39 percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

An increase of approximately 1,400 acres of this habitat type would occur in the first decade, and an additional increase of approximately 21,000 acres during the second decade of Plan implementation. At the end of the first decade, approximately 55 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

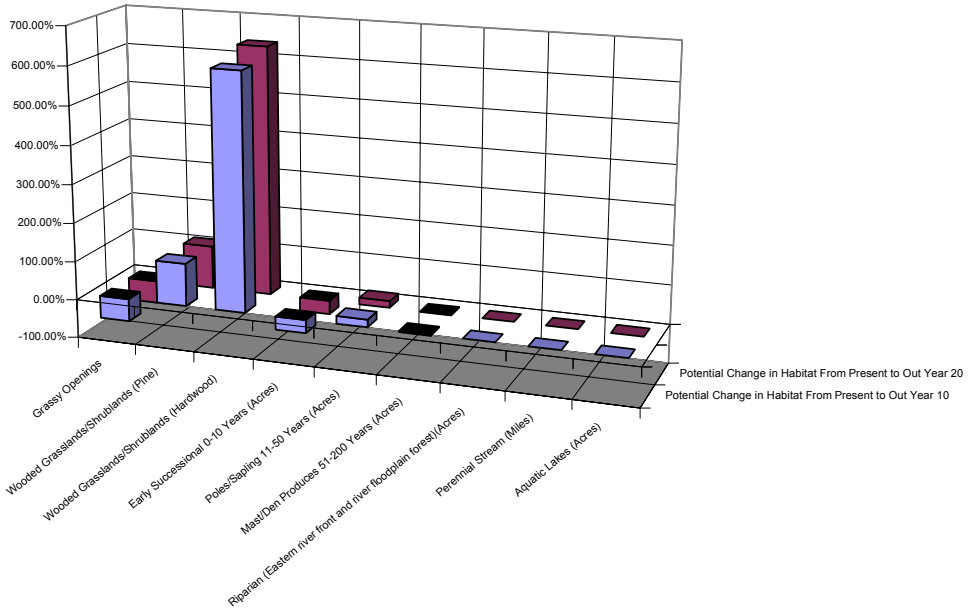

Figure 3 - 41. Potential change in habitat types for Alternative E-1.

	Grassy Openings	Wooded Grassland/ Shrubland (Pine)	Wooded Grassland/ Shrubland (Hardwood)	Early Successional 0-10 Yrs.	Poles/ Saplings 11-50 Yrs.	Mast/Den Producers 51-200 Yrs.	Riparian (Eastern riverfront and river flood plain forest)	Perennial Stream (Miles)	Aquatic Lakes (Acres)
Potential Change in Habitat through Year 10	-58.54%	110.0%	610.0%	-33.98%	19.68%	-2.56%	0.0%	0.0%	0.0%
Potential Change in Habitat through Year 20	-58.50%	110.0%	640.0%	-35.20%	17.60%	-1.90%	0.0%	0.0%	0.0%

Openings/Grassy

A decrease of approximately 1,300 acres of this habitat type would occur in the first ten years of implementation. These areas could be nonexistent by the end of the second decade. The decrease is attributed to the areas being overtaken by woody vegetation. In order to meet viability requirements, approximately 900 acres of this habitat type would be maintained. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Pine)

In order to meet viability requirements, approximately 110 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Wooded Grasslands/Shrublands (Hardwood)

In order to meet viability requirements, approximately 610 acres of this habitat type would be created in the first decade and maintained throughout the second decade. Other smaller areas may result from natural disturbance activities but would be short lived. At the end of the first decade, less than one percent of demand species habitat would be of this type.

Early Successional (trees 0-10 years old)

An increase of approximately 18,000 acres of this habitat type would occur in the first ten years. Approximately 36,000 acres of this habitat type would be maintained across the forest throughout the second decade. At the end of the first decade, approximately nine percent of demand species habitat would be of this type.

Poles/Saplings (trees 10-50 years old)

As a result of a maturing forest, a decrease of approximately 7,700 acres during the first decade, and an additional decrease of 8,000 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately thirty nine percent of demand species habitat would be of this type.

Mast/Den Producers (oak and hickory trees 50+ years old)

As a result of timber harvest activities, a decrease of approximately 5,211 acres during the first decade and an additional decrease of approximately 15,612 acres during the second decade of Plan implementation could be expected. At the end of the first decade, approximately 51 percent of demand species habitat would be of this type.

Aquatic (Lakes/Streams)

The practice of stocking trout and other fish is compatible with this alternative and would more than likely continue.

CUMULATIVE EFFECTS

None beyond those described in Effects Common to All Alternatives.

PARTNERS-IN-FLIGHT LANDBIRDS

Affected Environment

BACKGROUND

Evidence of declining population trends for many landbird species has focused concern on bird conservation. For this analysis, landbirds will include all avian species found on the Daniel Boone National Forest with the exclusion of waterfowl and shorebird species. To ensure that Forest Plan Revision efforts included provisions for bird species of concern, collaboration was conducted with the Division of Migratory Birds of the U.S. Fish and Wildlife Service under the umbrella of Partners-in-Flight (PIF). PIF is a cooperative effort involving federal, state, and local government agencies, foundations, professional organizations, conservation groups, industry, and the academic community. It was launched in response to growing concerns about declines in populations of Neotropical migrant birds. It has since expanded to include the conservation of songbirds not covered by existing conservation initiatives.

Neotropical migrant birds breed in North America but spend their non-breeding period primarily south of the United States. Numerous others are short-distance migrants or only occasionally visit the DBNF as transients.

PRIORITY SPECIES

The degree to which the DBNF is able to provide and maintain a diverse spectrum of habitat conditions directly influences the variety of bird life on the forest. Limitations of the landscape setting will preclude a significant presence of some bird species. The Partners-in-Flight list of priority conservation species will provide the focus for this analysis.

PIF developed a list of 36 priority bird conservation species for the Northern Cumberland Plateau physiographic region. Species are listed by common name in a descending order based on the score in Table 3 - 64. This process helps prioritize inventory, monitoring, management, and research needs.

The system ranks each species based on seven measures of conservation vulnerability: 1) relative abundance, 2 and 3) size of breeding and non-breeding ranges, 4 and 5) threats during breeding and non-breeding seasons, 6) population trend, and 7) relative density.

To further refine species prioritization within a physiographic area, PIF applied the following criteria:

- Population trends – Trends as reported from the Breeding Bird Survey
- Area of importance – Based on both detection rate on the Breeding Bird Survey routes and distribution within and beyond the physiographic area
- Percent of Breeding Bird Survey – Within the physiographic area
- Migratory status – Long-range verses short range migrants.

Rating scores ranged from a highest overall priority of 35 for the Bewick's wren, to a moderate level of local and regional concern of 17 for the grasshopper sparrow.

Table 3 - 64. Population Trend Indicators for Priority Bird Conservation Species on the Northern Cumberland Plateau.

Priority Conservation Species	PIF Score	R8 Bird Survey 1997-2000	Driving Route Survey 1993-2000	Forest Rank*	Breeding Status**	Habitat Factors
Highest overall priority						
Appalachian Bewick's Wren	35			X		
Red-cockaded Woodpecker	31			X		
Cerulean Warbler	30	[slight increase]	stable-increasing	3	B	
Golden-winged Warbler	29			P	B, ZN	High elevations
Swainson's Warbler	28	[stable-increasing]	[fluctuating]	2-3	B	
High overall priority						
Louisiana Waterthrush	26	[increasing-stable]	[fluctuating]	4	B	
Henslow's Sparrow	26			0		Strip mines
Worm-eating Warbler	25	[stable]	[stable]	4-5	B	
Acadian Flycatcher	25	[slight increase]		4-5	B	
Wood Thrush	25	[stable]	decline-stable	4-5	B	
Prairie Warbler	25	[stable]	[stable]	4	B	Management-altered habitat
Bachman's Sparrow	25			X	B	
Kentucky Warbler	24	declining	[fluctuating-stable]	4	B	
Yellow-throated Vireo	22	[increasing]	increasing	4-5	B	
Summer Tanager	22	[stable-increasing]	[increase-stable]			
Eastern Wood-Pewee	22		[fluctuating]	4	B	
Black-throated Blue Warbler	22				ZN	
Hooded Warbler	22	[stable]	[stable]	5	B	
Physiographic area priority						
Red-headed Woodpecker	21		[stable-fluctuating]			
Yellow-breasted Chat	21	[stable]	declining	4	B	Management-altered habitat
Field Sparrow	21	[fluctuating]	[stable]	3-4	B	Management-altered habitat
Northern Bobwhite	20	[declining]		3-4		Habitat is naturally limited
Gray Catbird	20	[declining-stable]	[fluctuating-declining]			
Black-and-white Warbler	20	[stable]	[stable-increasing]			
Ruby-throated Hummingbird	19	[stable]	[stable]			
American Redstart	19	[slight increase]	[fluctuating]			
Eastern Towhee	19	increase	declining			
Monitoring Priority						
Yellow-throated Warbler	21	increase	[stable]	4	B	
Global priority						
Prothonotary Warbler	21		[stable]	?		
Chuck-will's-widow	19			2	B	Habitat is naturally limited
Local or regional interest						
Common Raven	---			1		Pine Mountain
Whip-poor-will	20		declining-stable	4	B	
Chestnut-sided Warbler	20	[declining]	[fluctuating-decline]			
Blackburnian Warbler	19				ZN	
Grasshopper Sparrow	17					
Northern Harrier	---					

*Forest Rank Codes:

? = Unranked on the Forest

0 = No known occurrences on the Forest

1 = Extremely rare; critically imperiled on the Forest; generally 1-5 occurrences

2 = Very rare or imperiled on the Forest, generally 6-20 occurrences

3 = Rare and uncommon on the Forest, generally 21-100 occurrences

4 = Widespread, abundant, and apparently secure on Forest

5 = Demonstrably secure on the Forest

H = Historical records on the Forest, may be rediscovered

P = Potential for occurrence on the Forest

X = Extirpated from the Forest, not likely to be rediscovered

**Breeding Status Codes:

B = Breeds on the Forest

ZN = Transient

Of these 36 priority species, habitat on the DBNF currently helps sustain populations of 24 breeding species. Others are either not forest-associated species, or are limited by elevation or extirpated. Some are not known to have occurred on the forest.

Population trends for most species of concern known to occur on the DBNF have been assessed locally using the R8 Bird Survey and Driving Route Survey. Results indicate that eight of these species show some sign of decline on the forest. One species (red-cockaded woodpecker) was recently extirpated due to the loss of the yellow pine component on the forest resulting from an outbreak of the southern pine beetle. On the other hand, the golden-winged warbler was found for the first time on the forest during 2002. This may indicate a need to assess habitat conditions specific to these species.

The recently developed "forest rankings" by NatureServe (NatureServe 2002) offers another assessment of these species of concern. This forest-specific status determination was conducted cooperatively with State Heritage Agencies. Forest rankings provide an independent assessment of rarity as determined by experts outside the Forest Service.

Table 3 - 65 links management activities addressed in the evaluation of each Alternative to the above list of concern species.

Table 3 - 65. Cross reference of habitat/management parameters (Table 3-68) with primary concern species (Table 3-66).

PARAMETERS	MANAGEMENT ACTIVITIES	PRIMARY SPECIES OF CONCERN *
Streams & Riparian	In riparian habitat, provide a relatively open understory condition, which includes shrubs such as rhododendron and mountain pepperbush, within 75-150 ft. of perennial streams.	ACFL, LOWT
	Avoid creating openings and roads within riparian hemlock stands.	CERW, WEWA, ACFL, WOTH, KEWA, EAWP, BTBW, HOWA, YTWA, BHVI
	Develop and maintain at least 80% of the Hemlock-White Pine type in a mature/old-growth condition, with a thick shrub sapling understory.	CERW, WEWA, ACFL, WOTH, KEWA, EAWP, BTBW, HOWA, YTWA, BHVI
Grassland	Wooded grassland, woodland, and grassy openings will provide habitat to support open forest grassland species.	HESP, FISP, NOBO, GRSP, NOHA
	Emphasize restoration and maintenance of warm season grasslands to the extent practical. Rehabilitate fescue dominated areas, such as strip mine areas and other openings.	HESP, FISP, NOBO, GRSP, NOHA, BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
Fire	Develop and maintain the pine-grassland forest community using prescribed fire.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Develop an open canopy savannah forest with a dense understory and semi-open shrub layer.	PRAW
	Develop and maintain an open grassland-savannah habitat in large units to support associated species.	HESP, FISP, NOBO, GRSP, NOHA
	Apply fire and thinning to develop and maintain the pine-grassland community.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
Pine	Restore shortleaf and pitch pine to suitable sites.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Implement artificial regeneration methods to supplement natural regeneration of yellow pine.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Thin young yellow pine stands to stimulate growth.	RCWO
	Where opportunities arise, replace less desirable or off-site pine species with desirable, native pine species.	RCWO, BASP, YTVI, EAWP, YTWA, RHWO, EATO, BHVI
	Restore and maintain about an 18-24% pine dominated forest types on suitable sites as historically distributed.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
Shrub Habitat	Maintain an early succession shrub-sapling habitat condition on the Forest with an optimal patch size of 25 acres, ranging from 10-40 acres. Group or localize harvest sites to concentrate early successional habitat conditions. Locate regeneration areas outside or at the periphery of interior mature forest habitat.	BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
	Provide semi-open canopy with dense woody understory maintained by periodic disturbance in moist ravines and bottomland riparian with deep shade and dense vegetation, including canebrakes.	SWWA
	Schedule shrub-sapling areas on a 5-year schedule (regeneration).	BEWR, GWWA, PRAW, YBCH, GRCA, EATO, CSWA
Mature Forest	Thin mesic oaks and mixed mesophytic hardwood forest to perpetuate a semi-open canopy and sustain a dense understory layer.	KEWA
	Manage to provide old-growth habitat representation across the Forest, representative of all major forest habitats.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
Management Practices	Provide for forest interior species by grouping or localize harvest sites. Concentrate early successional habitat outside or at the periphery of mature interior forest.	WEWA, WOTH, KEWA, YTVI, SUTA, EAWP, BTBW, HOWA, BWWA, RTHU, WPWI AMRE, LOWT, ACFL, RHWO, CWWI, BLBW, CORA, CERW, BHVI, RCWO
	Provide and maintain representation of all successional stages and natural vegetative diversity.	ALL

*Species of Primary Concern. Standard name abbreviations from the American Ornithological Union.

Some species listed above are also Management Indicator Species: ACLF, CERW, FISP, NOBO, PRAW, YBCH, EATO, and SUTA.

COMMUNICATIONS TOWERS

Communications towers are a documented source of mortality for migratory birds. Two mechanisms of bird mortality commonly occur at communications towers. Birds flying in poor visibility conditions may not see the structure (i.e., blind collision). Towers lighted at night for aviation safety may help reduce blind collisions, but they bring about a second mechanism for mortality. Low cloud ceilings or foggy conditions refract light, creating an illuminated area around the tower. Migrating birds can then lose their stellar cues for nocturnal migration. With no broad orienting perspective on the landscape, the lighted area around a tower may be the strongest cue for navigation, and birds may linger in the illuminated space. As more and more passing birds concentrate into the relatively small, lighted space, mortality can occur when birds collide with the structure, guy wires, or even other migrating birds. The lights apparently do not attract birds from afar, but hold birds that pass within the vicinity.

ANALYSIS AREA

For the purpose of assessing the effects on PIF landbirds, the area that affects the Alternatives or that is being affected by the Alternatives includes all lands within the DBNF proclamation boundary.

Environmental Effects

Because migratory and resident landbirds are so ubiquitous and diverse, they are relevant to the majority of ecological communities and habitat elements considered during forest planning. Accordingly, provisions for these species are integrated into numerous Forest Plan Objectives and Standards focused on achieving desired habitat conditions.

RESOURCE TABLE

Each Alternative promotes a different combination of habitat conditions. The 21 habitat parameters and management activities identified in Table 3 - 66 can be used to improve overall Forest conditions for avian species of concern. These habitat parameters, developed collaboratively with the U.S. Fish and Wildlife Service, Division of Migratory Birds, were largely taken from the Northern Cumberland Plateau Bird Conservation Plan. Each Alternative would provide for these habitat elements to varying degrees. The Alternatives were evaluated on their ability to provide suitable habitat within management limitations in the following order:

0 = No appreciable habitat contribution

1 = Minimal habitat contributions

2 = Partial level of habitat provided

3 = Near optimal habitat provisions.

Table 3 - 66. Management activities, by Alternative, which will benefit DBNF birds considered by Partners-in-Flight to be Priority Bird Conservation Species (Northern Cumberland Plateau Bird Conservation Plan, November 28, 2000).

	Alternative Benefit Score*						Rationale					
MANAGEMENT ACTIVITY	A	B-1	C	C-1	D	E-1	Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Streams & Riparian In riparian habitat, provide a relatively open understory condition, which includes shrubs such as rhododendron and pepperbush, within 75-150 ft. of perennial streams.	1	2	3	3	2	2	Potential streamside vegetation manipulation & disturbance.	Reduced streamside management emphasis.	Riparian management to provide a streamside shrub component for stream associated bird species.	Riparian management to provide a streamside shrub component for stream associated bird species.	May have increased streamside recreational disturbances.	Reduced streamside management emphasis.
Avoid creating openings and roads within riparian hemlock stands.	1	2	2	2	1	2	Potential roading in bottomland/riparian hemlock stands.	Existing roads, except where viability concerns may exist.	Reduce riparian roading and void new construction in white pine-hemlock stands.	Reduce riparian roading and void new construction in white pine-hemlock stands.	Reduce riparian roading and void new construction in white pine-hemlock stands. Potential exists for recreational roading.	Reduce riparian roading and void new construction in white pine-hemlock stands.
Develop and maintain at least 80% of the Hemlock-White Pine type in a mature/old-growth condition, with a thick shrub sapling understory.	1	3	2	2	2	2	Suitable for the production of timber, 70-year rotation age.	All riparian hemlock-white pine will tend to old age conditions.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.	Management provision for mature/old-growth hemlock-white pine.
Grassland Wooded grassland, woodland, and grassy openings will provide habitat to support open forest grassland species.	0	0	2	2	2	0	No large grassland areas.	No large grassland areas.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	83,300 acres of savannah and woodland habitat managed in the pine and oak types, contributing to the support of grassland associated species.	No large grassland areas.
Emphasize restoration and maintenance of warm season grasslands to the extent practical. Rehabilitate fescue dominated areas, such as strip mine areas and other openings.	0	0	3	3	2	0	Outside of DFC, low priority.	Outside of DFC, low priority.	Convert fescue & sericea lespedeza to warm season grasses.	Convert fescue & sericea lespedeza to warm season grasses.	Convert fescue & sericea lespedeza to warm season grasses, within reduced habitat mgt. budgets.	Outside of DFC, low priority.

MANAGEMENT ACTIVITY	Alternative Benefit Score* A	B-1	C	C-1	D	E-1	Rationale Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Fire Develop and maintain the pine-grassland forest community using prescribed fire.	1	1	3	3	3	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	Restore & manage yellow pine dominant forest, with fire.	Restore & manage yellow pine dominant forest, with fire.	Restore & manage yellow pine dominant forest, with fire.	Limited minimum level burn acres forestwide.
Develop an open canopy savannah forest with a dense understory and semi-open shrub layer.	1	1	3	3	3	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Savannah/woodland conditions (pine & oak types) will provide a grassland habitat component, contributing to the support of the prairie warbler.	Limited minimum level burn acres forestwide.
Develop and maintain an open grassland-savannah habitat in large units to support associated species.	1	1	2	2	2	1	Limited minimum level burn acres forestwide.	Limited minimum level burn acres forestwide.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	24,500 acres of savannah (pine & oak types) managed to provide a grassland habitat condition.	Limited minimum level burn acres forestwide.
Apply fire and thinning to develop and maintain the pine-grassland community.	3	1	3	3	3	1	A significant grass component will not occur in the pine type due to production stocking.	Custodial emphasis will limit improvement opportunities for pine.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Thinning and burning will be used to maintain the pine savannah habitat condition.	Pine thinning and burning will occur to promote timber production and reduce potential for catastrophic wildfire.
Pine Restore shortleaf and pitch pine to suitable sites.	3	0	2	2	2	1	About 21% of the forest is planned for pine management.	Custodial emphasis will limit pine restoration.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	About 12% of the matrix area will be managed in pine and pine-hardwood forest types.	Pine is medium value, minimal restoration for viability purposes only.
Implement artificial regeneration methods to supplement natural regeneration of yellow pine.	3	0	2	2	2	1	Most pine regeneration will be artificial to control stocking and apply genetically improve seedlings.	Custodial emphasis will limit potential for pine restoration.	Most pine restoration will require site preparation and planting.	Most pine restoration will require site preparation and planting.	Most pine restoration will require site preparation and planting.	Pine restoration will be very limited, and accomplished using artificial methods.
Thin young yellow pine stands to stimulate growth.	0	0	2	2	2	0	Economically a low treatment priority.	Not appropriate under custodial management.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Desired TSI treatment to develop suitable RCW foraging habitat and accelerate tree growth.	Uneconomical, very low treatment priority.

MANAGEMENT ACTIVITY	Alternative Benefit Score* A	B-1	C	C-1	D	E-1	Rationale Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Where opportunities arise, replace less desirable or off-site pine species with desirable, native pine species.	0	0	2	2	2	0	Based on the economics and site-specific timber sales opportunities.	Not appropriate under custodial management.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Restoring pine on appropriate and suitable sites is a priority in addressing biodiversity.	Long-term, based on the economics of site specific timber sales.
Restore and maintain about an 18-24% pine dominated forest types on suitable sites as historically distributed.	3	1	3	3	3	2	Long-term objectives in the 1985 Plan are: 21% Y.Pine and 6% mixed.	Minimal pine restoration under custodial management. Without an active prescribed burning program (custodial) composition will tend to hardwood.	Provides for about a 20-25% pine dominate forest.	Provides for about a 20-25% pine dominate forest.	Provides for about a 20-25% pine dominate forest.	Provides for about 12% of the forest matrix in pine.
Shrub Habitat Maintain an early succession shrub-sapling habitat condition on the Forest with an optimal patch size of 25 acres, ranging from 10-40 acres. Group or localize harvest sites to concentrate early successional habitat conditions. Locate regeneration areas outside or at the periphery of interior mature forest habitat.	3	0	2	2	2	3	About a 10% harvest and regeneration rate per 10 year period.	No harvest and regeneration planned, with about a 1% natural disturbance component.	About a 5% harvest and regeneration rate per 10 year period.	About a 5% harvest and regeneration rate per 10 year period.	About a 5% harvest and regeneration rate per 10 year period.	About a 10% harvest and regeneration rate per 10 year period.
Provide semi-open canopy with dense woody understory maintained by periodic disturbance in moist ravines and bottomland riparian with deep shade and dense vegetation, including canebrakes.	2	0	3	3	3	0	Shrub development will result from timber production objectives in the 100-year flood plain.	Riparian habitat manipulation is limited within custodial management.	Develop canebrakes and dense woody understory patches in riparian habitat.	Develop canebrakes and dense woody understory patches in riparian habitat.	Develop canebrakes and dense woody understory patches in riparian habitat.	Reduced emphasis on veg. manipulation in riparian areas.
Schedule shrub-sapling areas on a 5-year schedule (regeneration).	2	0	1	1	1	2	10 year order-of-entry affecting about 1% of the matrix acres annually.	Activities scheduled as needed to meet minimal disturbance objectives.	10-year order of entry affecting about 0.5% of the matrix acres annually.	10-year order of entry affecting about .5% of the matrix acres annually.	10-year order of entry affecting about .5% of the matrix acres annually.	10 year order-of-entry affecting about 1% of the matrix acres annually.

MANAGEMENT ACTIVITY	Alternative Benefit Score* A	B-1	C	C-1	D	E-1	Rationale Alternative A	Alternative B-1	Alternative C	Alternative C-1	Alternative D	Alternative E-1
Mature Forest Thin mesic oaks and mixed mesophytic hardwood forest to perpetuate a semi-open canopy and sustain a dense understory layer.	1	1	3	3	3	1	Thinning provided, but low priority in management.	Existing forest composition and structure (no thinning).	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning in mesic oak and mixed mesophytic types prescribed. Mid-density upland forest to be maintained at 60-90 BA.	Thinning provided, but low priority in management.
Manage to provide old-growth habitat representation across the Forest, representative of all major forest habitats.	1	3	3	3	3	2	No designated old-growth.	Entire forest will move toward old-growth, within limits of natural disturbance.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	Dry-mesic oak, mixed mesophytic hardwood, and beech forest types are designated for old-growth management.	A representative beech component is designated for old-growth management.
Management Practices Provide for forest interior species by grouping or localize harvest sites. Concentrate early successional habitat outside or at the periphery of mature interior forest.	1	3	2	2	2	1	Regeneration harvest is planned at about 10% per 10-year period.	A minimum amount of harvest planned, mostly natural disturbance events.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	40-acre regeneration harvest opening limitation, about 5% per 10-year period. Most of the matrix forest will be in a high canopy forest condition, providing large areas of interior habitat.	Regeneration harvest is planned at about 10% per 10-year period.
Provide and maintain representation of all successional stages and natural vegetative diversity.	1	1	3	3	3	2	Lack well distributed old age structure.	Minimal provisions for early seral forest species.	Optimal biological diversity within forest management limitations.	Optimal biological diversity within forest management limitations.	Optimal biological diversity within forest management limitations.	Old age forest structure is under represented.
Total Score:	29	20	51	51	48	25						
Average Score:	1.4	1.0	2.4	2.4	2.3	1.2						

* Scoring Criteria: 0 = No appreciable habitat contribution; 1 = Minimal habitat contributions; 2 = Partial level of habitat provided; 3 = Near optimal habitat provisions within management limitations.

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Existing communication towers on the Forest are potential sources for mortality of migratory birds. Towers exist, or in the future may be placed, at 14 locations on the Forest. These sites include 14 towers, distributed from Morehead to near Manchester. Most are owned by the state of Kentucky and operated as part of the Kentucky Emergency Warning System. The Rural Electric Cooperative Corporation operates one of the two towers at McKee. AT&T operates one tower south of Parkers Lake on the Stearns District.

CUMULATIVE EFFECTS

Interest in tower construction is expected to grow on the Daniel Boone and elsewhere. Potential adverse effects from new construction on migrating bird populations can be expected. Any new requests for tower construction on the Forest will be addressed through a special use authorization application process.

Because migratory birds cover such large areas, their conservation is dependent on the distribution of suitable habitats across large regions. Currently, National Forests provide some of the largest blocks of forested habitat when viewed on a regional scale. As habitat quality and quantity continue to decline on many private lands, National Forest System lands will become more critical to migratory birds in the future.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Under this Alternative the 1985 Plan would continue to be implemented, only partially addressing habitat needs for bird species of concern. Alternative A scored an average 1.4 of a possible 3 points toward meeting habitat provisions for landbirds (See parameters in Table 3 - 66). Some habitat provisions were fully addressed by the Alternatives, such as maintaining adequate representation of early aged forest and associated shrub habitat conditions.

This Alternative would provide a diverse age-class structure, with the exception of old-growth, throughout the Forest with potential for about 9 percent in each 10-year age class. Shrub/sapling species associated with early-aged forest habitat, such as the yellow-breasted chat and eastern towhee, should prosper from an abundance of suitable conditions well distributed across the Forest. The mature forest character should evolve into a closed canopy structure with a limited or relatively open understory. Thinning would be applied primarily on an economic basis. Species such as the ovenbird and red-eyed vireo should do well. Forest species that nest and forage in the shrub layer would be reduced, however. With the exception of maintained openings, grassland conditions are not a normal part of the DBNF. Controlled burning is a tool used on the Forest almost exclusively in the upland pine and pine-hardwood forest types.

Riparian area management in Alternative A would be applied to a streamside zone, primarily to maintain water quality. Riparian areas would be designated as suitable for timber production, under a

scheduled harvest. This could reduce habitat quality for species such as the Acadian flycatcher as well as interrupt habitat connectivity at harvest sites.

Pine restoration would be emphasized within the Red-cockaded Woodpecker Habitat Management Area in Alternative A. An estimated 40,000+ acres of mature pine-dominated habitat would be required to meet population recovery objectives. All Alternatives would move the Forest toward some level of long-term pine restoration. One primary collective difference is that Alternative A would concentrate pine restoration on a designated area based on recent historic distribution of the red-cockaded woodpecker. The other Alternatives would first endeavor to re-establish the pine forest on suitable sites and then, at some long-term date, assess and delineate management opportunities for the red-cockaded woodpecker. This could potentially reduce habitat connectivity for the RCW during the 10-year Plan period, pushing recovery efforts further into the future.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

The overall emphasis in this alternative is custodial in nature with a minimum of direct human influence. Alternative B-1 scored an average 1.0 out of a possible 3 in addressing habitat improvement parameters (See parameters in Table 3 - 66). This minimal score results primarily from the passive nature of custodial management. Under this management scenario, the Forest would trend toward old age conditions over time. Limited stand replacement disturbances would occur randomly across the landscape, limited to some degree by land-use patterns. Early-aged forest conditions and grassland habitat types would diminish, as would the many disturbance dependant bird species such as the yellow-breasted chat and eastern towhee. Grassy conditions would be found mostly in maintained sites such as utility rights-of-way and recreational openings. High-canopy forest nesting and foraging species should prosper. The understory shrub layer would gradually decline as the tree canopy closes. Shrub species like the hooded warbler and wood thrush would decline, finding suitable habitat mostly in tree-fall gaps and other limited disturbance sites.

Disturbance habitat species, including many high priority bird species, would be reduced, adding to the growing concern over declining population trends. Forest composition would gradually become more homogeneous, converting to shade-tolerant species and the loss of oaks. As the forest ages, large areas would eventually undergo massive changes in composition, resulting in erratic population fluctuations caused by insect infestations and disease. There would also be increased potential for the spread of insect and disease outbreaks to adjacent private lands.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVES C, C-1, D

DIRECT AND INDIRECT EFFECTS

These alternatives emphasize the maintenance of ecological processes and function while providing for multiple public benefits. About half of the forest would be actively managed and result in a relatively moderate level of habitat fragmentation. These Alternatives effectively meet most of the habitat improvement needs for landbirds on the Forest (Table 3 - 66), scoring 2.4, 2.4, and 2.3, respectively. These three Alternatives provide for a wide variety of habitat essential to sustaining the complex assemblage of forest birds found on the Northern Cumberland Plateau. Primary habitat components provided in support of priority bird species include:

1) Early seral forest conditions, both seedling and sapling habitat types, e.g., stand harvest and regeneration
2) Mature forest conditions with large trees, e.g., large snags, tree-fall-gaps, and high canopy structure
3) Semi-open high canopy structure to develop and maintain an understory shrub component, e.g., thinning and woodland conditions
4) Riparian habitat, e.g., shrub component, old/mature hemlock, connectivity
5) Pine component, e.g., pine restoration, fire maintained pine/hardwood habitat
6) Native grasses, including the warm-season grass community, e.g., openings and wooded grassland/shrubland habitat.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

With a management emphasis on production of goods and services, this alternative would only partially address habitat needs for bird species of concern. It collectively scored an average of 1.2 out of 3 toward meeting overall habitat improvement needs for landbirds. Some habitat provisions would be fully addressed by this Alternative, such as maintaining adequate representation of early-aged forest and associated shrub habitat conditions.

With the exception of well distributed old-growth, this Alternative would provide for a diverse age-class structure throughout the forest with potential for about 10 percent in each 10-year age class. Shrub/sapling species associated with early-aged forest habitat, such as the yellow-breasted chat and eastern towhee, would prosper with an abundance of suitable conditions distributed across the forest. The mature forest character would evolve into a closed canopy structure with a limited or relatively open understory. Thinning would be applied primarily on an economic basis. Species such as the ovenbird and red-eyed vireo would do well. Forest species that nest and forage in the shrub layer would be reduced. With the exception of maintained openings, grassland conditions are not normally part of the DBNF. Controlled burning on the forest is a tool used almost exclusively in the upland pine and pine-hardwood forest types. After burning, shrubs sprout vigorously.

The riparian area would be managed under provisions of the Riparian Corridor Prescription Area. Retention of the high canopy riparian forest would provide a degree of connectivity across the forest for species associated with the mature forest structure.

CUMULATIVE EFFECTS

None beyond those already described.

FRAGMENTATION

Affected Environment

Fragmentation, as related to forest management, results in habitat conversion, habitat discontinuity, and eventually the isolation or insularization of the original habitat. The process of fragmentation can occur across a range of landscape patterns. At one extreme, small disturbance patches that disrupt habitat continuity represent it. At the other extreme, widespread habitat conversion leaves only isolated remnants of the original habitat.

The concept of fragmentation is derived from the definition of habitat. Habitat is defined relative to an organism or group of organisms, and its definition will vary from broad to specific. Within the context of forest management, we can consider:

- Fragmentation of forested land by non-forest land uses
- Fragmentation of forest types or communities
- Fragmentation of forest age-classes or seral stages.

These three types of fragmentation have different effects. Fragmentation resulting from the conversion to non-forest land uses has the most impact on biodiversity by changing existing habitat for long periods or even permanently, while the remaining forest is left in smaller, more isolated patches (Figure 3 - 42, A). This type of fragmentation occurred mostly during early European settlement when forests were cleared for agricultural and industrial uses. Fragmentation of community types can have both beneficial and adverse effects, depending upon temporal and spatial considerations. A small inclusion of one habitat type in a large block of another type (e.g., a spring in a large dry forest) can provide a microhabitat that increases the biodiversity in an area. Also a dry forest community invading a barren or glade community, under fire suppression, can greatly reduce the biodiversity of the rare glade community. Fragmentation of forest age classes, which leaves a forest matrix intact but with different age classes or seral stages (Figure 3 - 42, B), can also have both beneficial and adverse effects, depending on species, spatial, and temporal considerations (USDA Forest Service 1995).

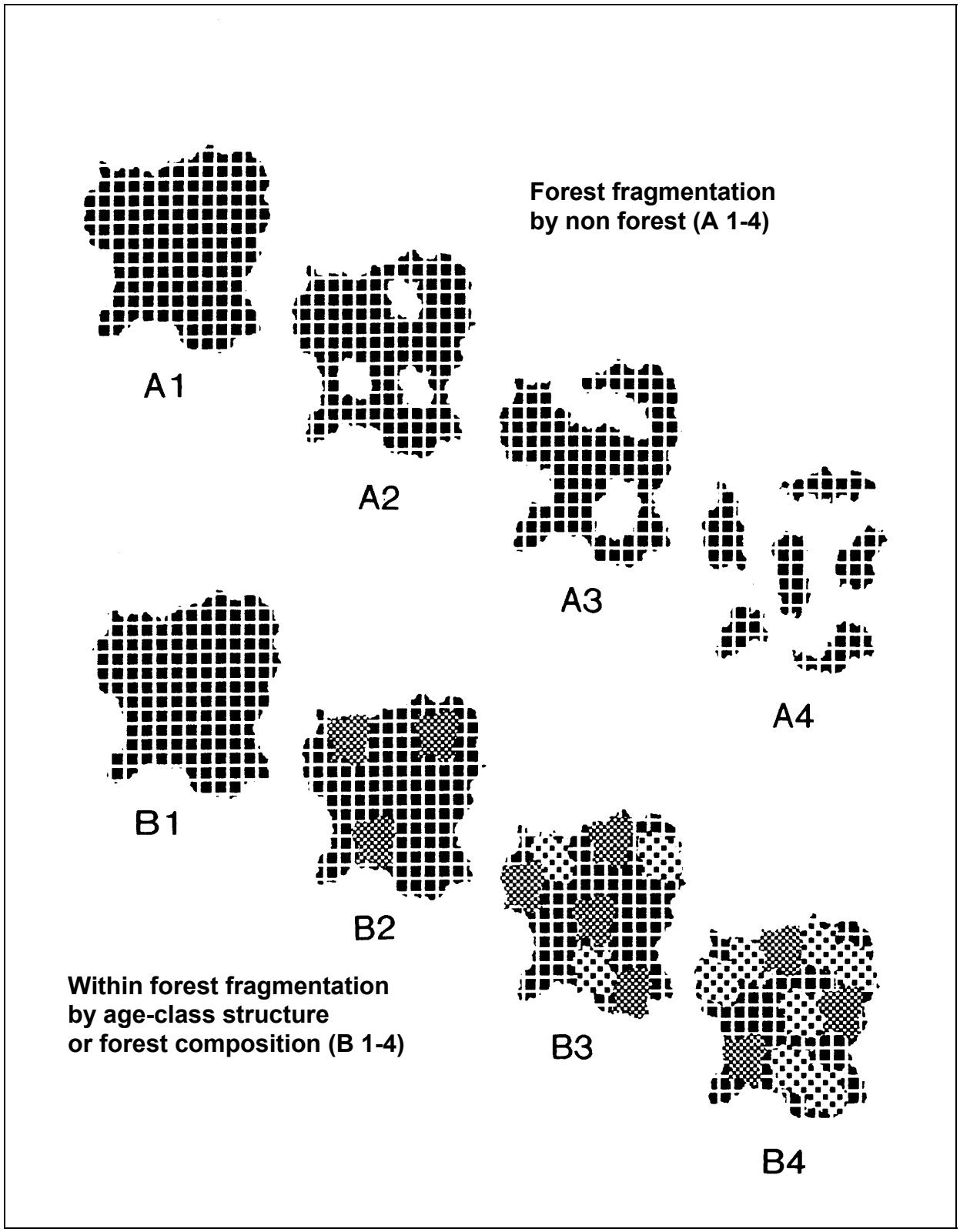

Figure 3 - 42. Types and Degrees of Fragmentation (USDA Forest Service 1995).

The issue of fragmentation may become exceedingly complex in examining potential spatial relationships and species behavioral characteristics within terrestrial habitats. To help simplify the issue and give focus to the primary concerns of fragmentation, this analysis is grouped to address effects as generated by non-forest land uses (forest fragmentation) and within forest effects of fragmentation.

FOREST FRAGMENTATION

Forest fragmentation, the division or isolation of forested land by non-forest land uses, is a subset of habitat fragmentation.

The amount of forest cover in an area and arrangement of forested areas in regard to farmland, urban, and residential land influences the mixture of plant and animal species. When forest tracts are widely separated by other land-use types or when forest constitutes only a small amount of the total cover, an area is considered a fragmented forest. A large forest area can become fragmented if land that once grew trees is converted to non-forest areas such as shopping centers, housing developments, parking lots, or major highways. Forest fragmentation may isolate populations of plants and animals that depend on large tracts of forested land, adversely affecting the long-term prospects of these populations. Converting forested land to other uses alters biodiversity by eliminating forest habitat, with remaining forest habitat reduced to small, widely separated patches.

Edge Effect

Edge is an ecological transition zone between two or more habitat types. In the context of forest fragmentation, edge is created where non-forest land abuts forest habitat. Edge conditions are often marked by a sharp contrast between forest habitat and adjoining non-forest land uses.

Edge effects extend beyond the physical edge of tree cover into the forest interior. Large contiguous blocks of forest tend to support more diverse fauna than smaller blocks because they can provide habitat for forest interior species. Interior species include black and white warblers, cerulean warblers, Acadian flycatchers, black-throated green warblers, and ovenbirds (Franzreb and Phillips, 1995). As the ratio of edge to interior habitat increases, habitat fragments can become small enough to exclude species that require large blocks of contiguous forest habitat. Habitat fragments smaller than a certain critical size are simply insufficient to support some species.

Edge effect in heavily fragmented forest landscapes has been documented to produce higher levels of disturbance, competition, predation, and nest parasitism than interior habitat (Muehler, 1997; Tilgham and Evans, 1986). These research results should be evaluated in the context of the conditions and locations studied. Studies on the effects of forest fragmentation on bird communities, documented in urban-agricultural dominated landscapes, may not be applicable to forest dominated landscapes (Petit et al., 1995).

Donovan et al. 1997 examined 75,000-acre study areas (hexagonal analysis areas 18 km. per side) in Illinois, Indiana, and Missouri. The amount of forest cover at the landscape scale included (1) highly fragmented (<15% forest cover), (2) moderately fragmented (45-55% forest cover), and (3) unfragmented (>90% forest cover) landscapes. They found that within-forest edge effects depend at least in part on landscape character. Nest predation by mammals tended to be greater in highly fragmented landscapes than in unfragmented landscapes. Avian predation patterns did not differ

among landscapes, but differed between edge and core habitats. Hunter (pers. comm.) found the effects of predation and parasitism of within-forest habitat fragmentation to be of little impact to bird productivity where landscapes are less than 70 percent forested. According to the *Southern Forest Resource Assessment* Baker and Hunter (2002, p.94) that included the Cumberland Plateau and Mountains ecoregions, within-forest fragmentation was not a substantial problem in heavily forested areas, 70 percent or more forest.

Forest fragmentation and its associated effects (increased edge, reduced patch size, increased rates of predation, increased rates of nest parasitism) have been identified as a contributing factor in the decline of some songbird species, particularly that group referred to as Neotropical Migrants (Robbins, 1988; Robinson, 1997; Franzreb and Phillips, 1995). Neotropical migrant birds nest in spring and summer in North America and during the winter months they migrate to Mexico, the Caribbean, Central America, and South America. The Breeding Bird Survey data from 1966 to 1998 indicates that approximately 32 percent of this species group has exhibited significant ($p<0.1$) negative population trends over the period. In contrast, fourteen percent have exhibited significant ($p<0.1$) increases (USGS 2000).

Nest Parasitism

Nest parasitism is often cited as a potential reason for long-term population declines in a number of forest bird species, particularly forest interior species. The brown-headed cowbird, which frequents agricultural/residential landscapes and edge habitats, is undoubtedly North America's most widespread and best-known brood parasite. Rather than building its own nest and raising its own young, the brown headed cowbird lays its eggs in the nests of other birds and relies on those other birds, or hosts, to incubate and raise its young. Reproductive success in some host species can be markedly reduced as a result. Other host species may be able to make up reproductive success lost to parasitism (Muehler 1997; Whitehead et al. 2000). Parasitism rates tend to be low in grassland habitats, and many grassland species have developed behavioral adaptations against cowbird parasitism (Muehler 1997; Peer et al. 2000).

A study by Donovan et al. 1997 found that in unfragmented forest landscapes, cowbird abundance tends to be greater along edges. This may be because cowbird-feeding opportunities in such landscapes are limited, or because cowbird numbers are low and ample hosts exist close to the edges. There also may be energetic costs to penetrating deep into forest interior habitats.

Robinson et al. 1995 examined 10 kilometer-radius study sites in Illinois, Indiana, Minnesota, and Wisconsin. In heavily forested landscapes, they found cowbird populations might be limited more by foraging opportunities than by host availability. In more fragmented landscapes, on the other hand, the cowbird populations may be more limited by the availability of hosts and may saturate the available breeding habitat, resulting in high levels of parasitism even in the interior. Therefore, landscape level factors, such as percentage of forest cover, determine the magnitude of local factors, such as within-forest tract size and distance from the forest edges.

Forest Fragmentation in Kentucky

Significant numbers of humans have occupied this area for at least 1,000 years. Consequently, much of this landscape has been influenced by human activities for much of this time. Some plant and animal species have benefited from human-caused forest fragmentation, and others have not.

Contrary to a common misconception, Kentucky is gaining forest land. The forest land acreage within the Commonwealth of Kentucky increased by 253,300 acres from 1982 to 1997 (Figure 3 - 43). Most of the increase can be attributed to pastures reverting to woodland and to tree plantings. However, much farmland is also being converted to urban and other non-forest uses. Once this type of conversion occurs, the land is unlikely to revert to forest. The following land use changes occurred in Kentucky from 1982 to 1997 (NRCS 2000):

- Loss of 726,700 acres of cropland
- Loss of 273,900 acres of pastureland
- Loss of 291,200 acres of other land (Minor Uses)
- Gain of 253,300 acres of forest land
- Gain of 88,700 acres of federal land
- Gain of 595,600 acres of urban uses and roads

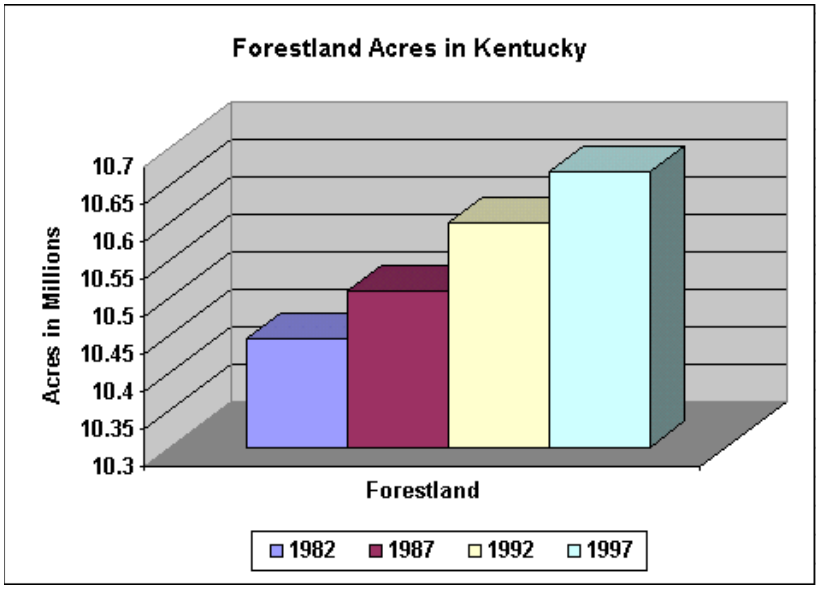

Figure 3 - 43. Forest land Acres In Kentucky.

The same increase in forest land appears to be true for the proclamation area of the Daniel Boone National Forest. When one compares aerial photographs taken of the Daniel Boone National Forest in 1939 to those taken in 2002 one finds that much of the farmland that was present in the early 1900s has grown up in forest.

The Daniel Boone National Forest is predominantly forest surrounded by forest. At this time, 34 percent of the land within the proclamation boundary is National Forest System land, distributed in a patchwork pattern over 21 counties. As of 2001, approximately 670,000 acres, or 98 percent of the land on the Forest was in a forested condition. Approximately 14,000 acres (2%) was in non-forest uses such as parking lots, administrative sites, and permitted uses such as water pumping stations, mineral developments, and major highways.

Within the proclamation boundary of the Forest, 95 percent of the land is in a forested condition (Table 3 - 67). Therefore, most private land surrounding the DBNF is forested. Satellite imagery indicates a slight land use trend toward forested conditions from 1978 to 1998.

Table 3 - 67. Forested and non-forested land use on the DBNF and the Northern Cumberland Plateau (National Land Cover Data Set, Commonwealth of Kentucky).

	DBNF				Northern Cumberland Plateau[2]	
	1978		1998		1998	
Land Use	Adjusted Acres[1]	Percent of Total Acres	Adjusted Acres	Percent of Total Acres	Acres	Percent of Total Acres
Forested	1,864,400	91%	1,959,654	95%	2,554,057	81.6%
Non-forest	178,074	9%	64,145	5%	577,280	18.4%
Total	2,042,474		2,042,474		3,131,337	

[1] Some inconsistencies in satellite imagery interpretation and applied land use categories exist between coverages. Acres have been adjusted to more accurately reflect known DBNF acreages.

[2] Northern Cumberland Plateau outside the DBNF Proclamation boundary in KY, SubSections 221Ha, 221Hb, 221Hc, 221He (USDA Forest Service, July 1994). Ecological Subregions of the U.S.: Section Descriptions. WO-WSA-5, p. 16-8 & 9.

On a broader scale, the Northern Cumberland Plateau ecoregion is somewhat less forested. About 612,624 acres (88.3%) of the Daniel Boone lies within this section. That portion of the Northern Cumberland Plateau outside of the Forest proclamation boundary, within Kentucky, is 81.6 percent forested. This indicates a potentially heightened degree of importance the Forest, and the immediate surrounding area, plays in sustaining species dependant on, or closely associated with, the eastern broadleaf forest of this physiographic region.

Further examination of land use, forest versus non-forest, was conducted using the National Land Cover Data Set (1998) to assess the potential interior forest land across the landscape (Table 3 - 68). A roving neighborhood analysis of 75,000-acre circular units (about six miles radius) was conducted within the proclamation boundary of the forest, providing an average value of interior conditions. For example: If half the cells in the 75,000 acre circular neighborhood are forest (value = 100) and half are non-forest (value = 0), the average value calculated for the center point will be 50, therefore a 50 percent interior forest value is assigned to that cell.

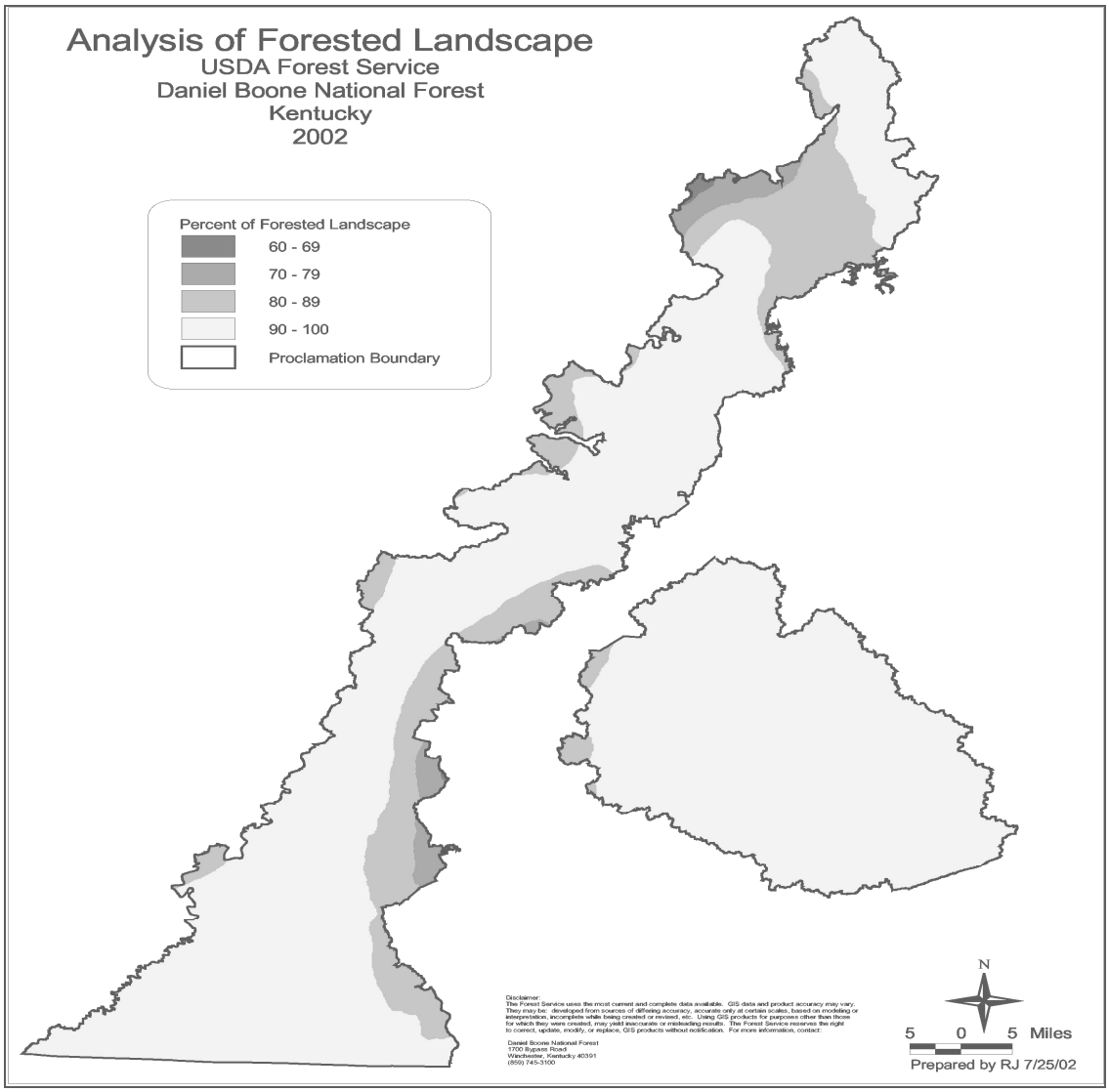

Figure 3 - 44. Analysis of the Forested Landscape.

Forest conditions dominate the landscape of the Daniel Boone (Figure 3 - 44). About 83 percent of the 75,000-acre analysis units are 90+ percent forested.

Table 3 - 68. Results of roving neighborhood analysis of forested habitat within the DBNF Proclamation Boundary using the 75,000-acre circular unit.

% OF FOREST COVER*	ACRES
60-69%	3,045
70-79%	42,974
80-89%	295,841
90-100%	1,700,503
Total	2,042,363

Percent of Forest Cover -- Calculated as the percentage of cells within the 75,000 circular units that are forested.

WITHIN-FOREST HABITAT FRAGMENTATION

In the context of forest management, within-forest habitat fragmentation is the interruption or isolation of forest habitat caused by changes in forest composition or communities, and/or changes in age-class conditions or seral stages. This is the primary facet of the fragmentation issue. The arrangement of tree species and age structure affects which plant and animal populations may be found in a forested area. This arrangement of forest habitat types across an area and the degree to which they are connected influences habitat suitability. An area where forest habitat types are small or not connected may limit suitability for some species. The implications of habitat fragmentation within the DBNF depend on habitat requirements for individual species. Many species thrive in a diverse mixture of habitats while others need more uniform habitats over a large area.

Habitat fragmentation within the forest is not a factor considered to be good or bad, but rather an element of species-specific habitat requirements. For example, a small wetland surrounded by hundreds of acres of dry ridge-top forest will greatly increase biodiversity in the forest. Likewise, a small patch of white pine surrounded by a large acreage of hardwood trees can provide roosting sites to many birds in inclement weather.

As with any activity that modifies habitat, results may favor some species while reducing suitability for others. Habitat modifications can be implemented to improve local conditions for rare or declining species, or they may be the result of natural disturbance, such as stand replacing fire or windstorm events. Forest ecosystems are dynamic and management has the opportunity to limit drastic changes that could potentially eliminate an entire suite of forest species or contribute to the demise of an already rare species.

Providing a highly diverse forest mosaic is essential to sustaining the wide variety of species found on the DBNF. Within-forest fragmentation is an integral part of developing and maintaining a biologically diverse forest. The continuum of natural communities on the DBNF ranges from open prairies to completely closed canopy cove forest. Woodlands, prairies, glades, and marshes are part of the mosaic of natural communities on the forest. Failure to conserve, maintain, preserve, and even to restore these communities will reduce biodiversity (USDA Forest Service, 1995). Projects planned to restore these ecosystems and provide habitat for the rare species that occupy them will fragment the surrounding forested habitat by opening up the canopy and causing discontinuity of the high canopy forest structure.

Taylor and Taylor (1979) identified 80 bird species associated with upland openings in northern forests. Pagen et al. (2000) illustrated the significance of early and mid-successional forest habitats as post-breeding habitat by some forest interior Neotropical migrant songbirds in Missouri. Rivera et al. (1998) observed similar behavior by post-fledging wood thrush in northern Virginia. They concluded that successful management of migratory species requires protection of habitat used during the post-fledging period as well as the breeding and nesting part of the life cycle.

Researchers have also documented the use of woodland openings by amphibians, reptiles and mammals (Adams et al., 1996; Campbell et al.; 1992; Pias et al., 1988). Burford and Lacki (1995) documented the use of openings as foraging habitat for the endangered Virginia big-eared bat. While they observed the highest percentage of use over old fields, they later found the majority of moth species consumed were dependent upon woody plant material for larval development (Burford and Lacki, 1998), demonstrating the importance of habitat diversity for this species.

Many factors have been identified as possibly contributing to the decline of Neotropical migrant songbirds. These factors include changes in land use on breeding grounds, losses of wintering habitat, reduction in migratory stopover habitat, climate change, pollution, and other factors such as the prevalence of domestic cats and collisions with towers and tall buildings (Robinson, 1997; Franzreb and Phillips, 1995).

As previously described, within-forest habitat fragmentation will not substantially limit the Forest's capability to sustain breeding populations of neotropical migrant birds and resident landbirds. However, habitat improvement opportunities may be considered to support population recruitment objectives for species that have demonstrated declines elsewhere in their range, such as the cerulean warbler (Plan Forestwide Objective 1.1.B.). Centers of abundance on the DBNF may provide source populations for areas of marginal habitat quality. Population sources are areas where reproductive success is high and a surplus of young are produced. Population sinks are areas with low reproductive success and the persistence of the population is dependent on immigration. This has important implications for the DBNF, suggesting that populations on individual forests are linked, and may even be dependent.

ANALYSIS AREA

For the purpose of assessing the effects of fragmentation on the forest, the area that affects the Alternatives or that is being affected by the Alternatives includes all lands within the proclamation boundary of the DBNF.

Environmental Effects

The primary elements of within-forest habitat fragmentation, considered in this analysis, are reduced interior forest habitat, habitat discontinuity, and high-density forest edge. These habitat conditions will change based on applied management activities. Resulting habitat suitability will be influenced by these changes, improving conditions for some species while reducing habitat quality for others. Species with requirements most closely associated with interior forest, habitat connectivity, and low-density forest edge will have the greatest potential to be affected.

Large tracts of older trees are believed to provide "interior habitat" for some species of birds and mammals. Within forest activities that break up tracts of mature forest may increase the amount of edge habitat relative to interior habitat.

Although forest edge may reduce habitat suitability for interior forest species it also adds habitat diversity. Edge habitat increases species richness and wildlife populations on a local level because the edge attracts wildlife species that use either type of habitat and those that use the transition between the two habitats (Meffe and Carroll, 1994; Tilghman and Evans, 1986).

Connectivity is the arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation (USDA Forest Service and USDI Bureau of Land Management, 1997). Forest habitat connectivity is an important consideration in providing for the movement of species in meeting seasonal needs, wide-ranging habitat requirements, genetic inter-change, and healthy population distributions. Connectivity is inversely related to fragmentation.

Many forest management activities affect the significance of these habitat elements as related to fragmentation. The following activities, Table 3 - 69, where identified as having high potential to substantially contribute to fragmenting effects and serve as a proxy to measuring within-forest habitat fragmentation. Direct measures of within-forest habitat fragmentation, such as patch size, habitat connectivity, and edge density, where not determined in this analysis.

RESOURCE TABLE

Table 3 - 69. Management parameters affecting within-forest habitat fragmentation.

MANAGEMENT PARAMETERS*	Alt. A	Alt. B-1	Alt. C	Alt. C-1	Alt. D	Alt. E-1
Area Suitable for Timber Production** (% of NFS land)	68%	6%	50%	50%	50%	53%
Acres	470,294	36,822	347,714	347,714	347,714	370,490
0-10 Age Class per Decade (% of NFS land)	7%	1%	3%	3%	3%	5%
Acres	50,000	7,000	22,279	22,279	22,279	36,364
Shortleaf Pine Restoration (% of NFS land)	5%	5%	6%	6%	6%	5%
Acres	35,259	33,000	42,000	42,000	42,000	33,000
Woodland Habitat (% of NFS land)	0%	0%	9%	9%	9%	1%
Acres	0	3,562	58,700	58,700	58,700	3,562
Grassy Openings and Wooded Grassland/Shrubland (% of NFS land)	<1%	<1%	3%	3%	3%	<1%
Acres	2,171	3,100	20,450	20,450	20,450	3,100
Level of Riparian Habitat Discontinuity	Moderate	Low	Low	Low	Low	Low
Within-Forest Habitat Fragmentation	**High**	**Low**	**Moderate**	**Moderate**	**Moderate**	**High**

*Management Parameters - are based on long-term management objectives and Desired Future Conditions.

**Area Suitable for Timber Production – suitable timberlands are those on which most vegetation manipulation occurs.

The potential for introducing fragmenting effects within the DBNF are greatest where manipulation of the high canopy overstory is planned. Therefore, the portion of the Forest where treatments to maintain a diversity of age structure and composition are scheduled will indicate the potential scope of effects. These affects may be relatively long-lived and additive, as needed to maintain a cycle of forest regeneration. [Suitable area, 0-10 age class, Pine restoration]

Woodland habitat is characterized by a low basal area (30-50 sq.ft./ac.) forest condition with a well-developed shrub/grass/forb layer, promoted by a regular cycle of burning. This habitat will be found on upland sites, in hardwood (primarily oak), yellow pine, and mixed forest types (see 1.K. Habitat Diversity Emphasis Prescription-Forest Plan). Edge effects created by this community, in contrast to adjacent high canopy forest (70+ sq.ft./ac.), will be relatively minor even at lower woodland basal area densities. Crown development within woodland habitats will diminish potential disruption of the forest canopy. Understory development will greatly add to habitat diversity on the Forest, providing potential habitat for an entire suite of shrub nesting and foraging bird species. [Woodland habitat]

Wooded grassland/shrubland is characterized as a high canopy, low basal area (10-29 square feet/acre) forest with a well-developed shrub/grass/forb layer. This habitat condition consists of mid- to old-age (50-160 years) canopy trees with thin to dense low shrubs (≤3 ft) or grasses/forbs, which are promoted by a regular cycle of burning. It will be found within the oak-dominated and yellow pine-dominated forest types. The development and maintenance of this forest community type will add to within-forest habitat fragmentation. Edge created with adjoining forest will be prominent and high canopy forest structure will be interrupted for some species. Overall effects across the forest landscape should be minor, well within the historic range of variability.

Arguably this habitat type could be considered a non-forest land use, predominantly a grassland/shrubland community, adding to deforestation within the DBNF proclamation boundary. This habitat condition does not presently exist on the forest. To make this determination, a comprehensive inventory of species occurrence is needed to evaluate effects. There may also be very different habitat characteristics and species representation at each end of the range of prescribed tree density. For this analysis, wooded grassland/shrubland will be considered forested habitat. [Wooded grassland/shrubland]

Riparian habitat is well distributed across the DBNF in a somewhat linear pattern. Activities that interrupt the mature forest condition within this area will reduce capability to provide a corridor for species movement. It may also reduce opportunities to provide for interior species such as the Louisiana waterthrush and Acadian flycatcher. [Riparian habitat]

EFFECTS COMMON TO ALL ALTERNATIVES

DIRECT AND INDIRECT EFFECTS

Forest Fragmentation

Forest fragmentation affecting National Forest System lands is expected to change very little over the Plan period. Less than one percent additional land would be developed into new recreation areas or be cleared for road and utility corridors. Land acquisition can be expected to continue at about the same rate. Since 1990, the net increase in National Forest System land ownership has been 34,825 acres, an average of about 2,900 acres per year. Non-forest conditions on private in-holdings should be reduced to a small degree through acquisition and reforestation. No substantial difference in the direct and indirect effects on forest fragmentation would be expected between Alternatives.

CUMULATIVE EFFECTS

All Alternatives would influence forest fragmentation similarly. Within the first decade of the planning period, there could be a slight decrease in forested land within the proclamation boundary due to development on private land. Most of the development on private land will occur at the expense of agricultural land, due to existing road access and landform. Forest fragmentation should not substantially change on National Forest System land.

ALTERNATIVE A

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

Under this alternative the 1985 Plan would continue to be implemented, providing a relatively high level of within-forest habitat fragmentation across the Forest landscape. Regeneration harvest would be highest in Alternative A, covering seven percent of the Forest, introducing the greatest amount of regeneration edge. This fragmenting effect would persist through time until new forest stands again developed a high canopy forest character. Regeneration harvest activities would be distributed evenly over 68 percent of the Forest, lands suitable for timber production, potentially limiting options to provide interior forest habitat.

About five percent of the Forest would be restored to a pine-dominant community under this Alternative. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be necessary to maintain this fire mediated community. This would introduce forest edge conditions as well as fragmentation of mature forest habitat.

Alternative A also approaches riparian area management differently than any of the other Alternatives. Under current management, riparian habitat is regarded as suitable for timber production within specific filter strip and shade strip management provisions. This increases the potential for fragmentation of riparian habitat and reduces capability to link mature forest conditions.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE B-1

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

The overall emphasis of this Alternative would be custodial in nature with a minimum of direct human influence. It would result in the least amount of mature forest habitat fragmentation, as well as a more homogeneous age structure and composition across the DBNF. An abundance of interior forest habitat would be promoted. Plant and animal species associated with a relatively continuous uneven-aged forest would do well. Species associated with disturbance habitat types, including many high priority bird species, would be reduced, adding to the growing concern over declining population trends. Oak and pine ecosystems would be diminished to only where stochastic storm and fire events have produced canopy openings.

As the Forest ages, large areas would eventually undergo massive changes in composition resulting from insect and disease infestations, causing erratic population fluctuations and radical habitat fragmentation. There would also be an increased potential for the spread of insect and disease outbreaks to adjacent private lands with potential for radical habitat changes.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVES C, C-1, & D

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

These Alternatives would emphasize the maintenance of ecological processes and function while providing for multiple public benefits. About half of the Forest would be actively managed to provide a diversity of forest age-class structure. Planned activities within these Alternatives would result in a relatively moderate level of within-forest habitat fragmentation. Regeneration harvest activities would take place on about three percent for the DBNF, introducing a limited amount of regeneration edge. Large blocks of mature forest would be distributed across the planning area, supporting interior forest-dependent species.

About six percent of the Forest would be restored to a pine-dominant community under these Alternatives. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be necessary to maintain this fire-mediated community. This would introduce forest edge conditions and fragment some mature forest habitat.

The development and maintenance of woodland habitat in these Alternatives would introduce a component of edge, though to minor degree, since resulting habitat differences are less pronounced. Open forest conditions would provide for species associated with a prominent shrub layer as well as promote full crown development.

Development and maintenance of the wooded grassland/shrubland habitat type planned in these Alternatives would add to within-forest habitat fragmentation. Species richness on the forest would be improved, however, expanding opportunities for grassland-associated species such as the field sparrow, Henslow’s sparrow, and bobwhite quail.

Retention of riparian habitat, as provided in the Riparian Corridor Prescription, would provide an element of connectivity for high canopy forest structure across the DBNF.

CUMULATIVE EFFECTS

None beyond those already described.

ALTERNATIVE E-1

DIRECT AND INDIRECT EFFECTS

Within-forest Habitat Fragmentation

With its management emphasis on production of goods and services, this Alternative would generate a relatively high level of within-forest habitat fragmentation. Slightly over half of the Forest would be actively managed for timber products. Timber harvest would be concentrated in coves and on lower slopes where site quality is highest. Dry ridge tops would not be managed intensively. Differences would appear as the uplands develop into mature forests and the lower slopes into a variety of forest conditions. Future decades could see a reduction in oak dominance on ridge tops as the already mature trees die and are replaced by shade tolerant species such as red maple. Harvest and increased road building would disrupt habitat continuity and limit options for interior forest habitat.

About five percent of the Forest would be restored to a pine-dominant community under Alternative E-1. Intensive site disruption would be necessary to re-establish pine, and prescribed burning would be needed to maintain this fire-mediated community. This would introduce forest edge conditions and fragment some mature forest habitat.

Retention of riparian habitat, as provided in the Riparian Corridor Prescription Area, would lend some degree of connectivity to the high-canopy mature forest structure across the forest.

CUMULATIVE EFFECTS

None beyond those already described.

OTHER EFFECTS

Forest fragmentation resulting from changes to non-forest land-uses that are beyond the control of the Forest Service, e.g., highway development, private minerals extraction, and urban development and associated utility corridors, would occur.

The potential for the increased spread of non-native invasive species and their fragmenting effect on native populations would remain.